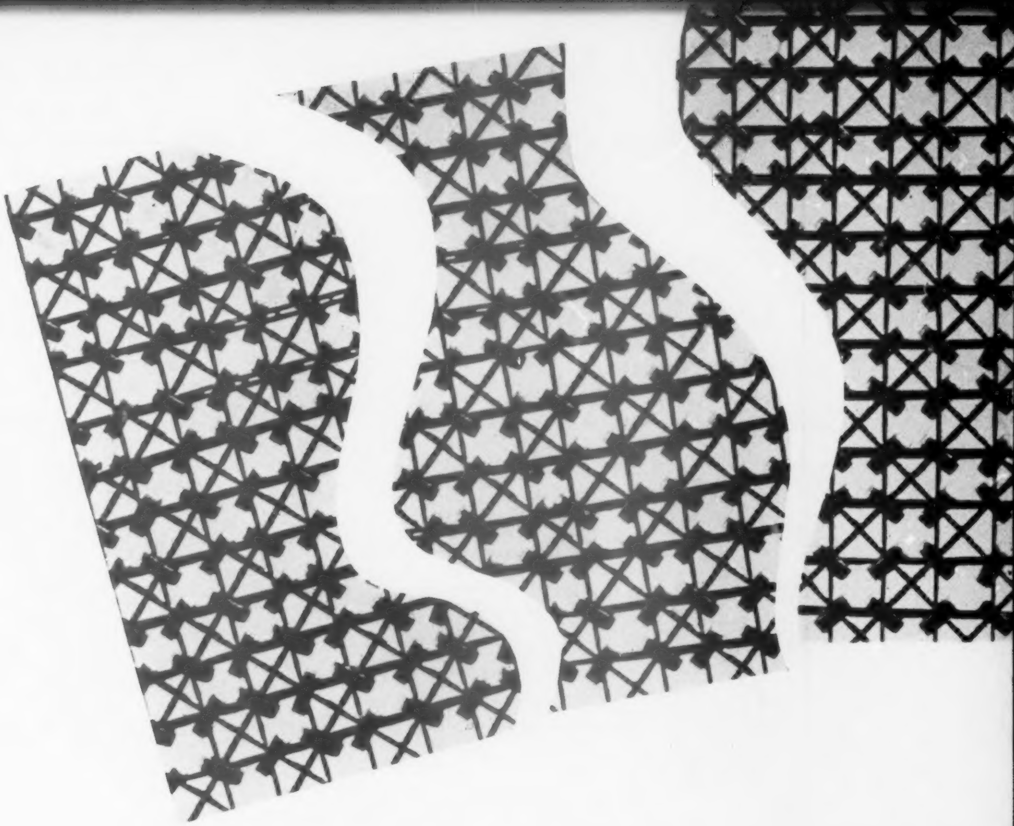
AUTOMATIC DATA PROCESSING
JULY 1959



MARKET FORECASTING   ORDER HANDLING   ACCOUNTING   FINANCIAL AND COST CONTROL   DELIVERY SCHEDULING   STOCK CONTROL
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Data Processing

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Vol 1 No 6

Automatic
Data Processing

VOL 1 No 6 CONTENTS JULY 1959

COVER PICTURE

A jig-saw pattern of memory cores from a Bull computer.

AUTOMATIC
DATA PROCESSING

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READING GUIDE

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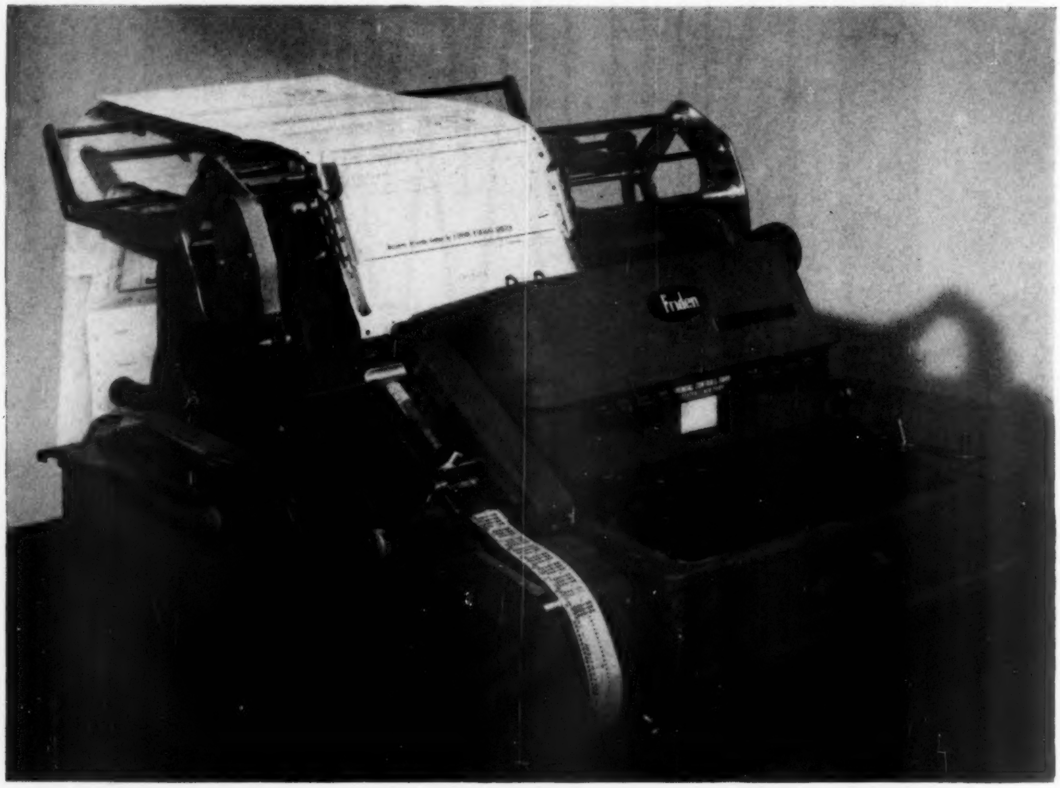
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COMMENT

The Meaning of Meaning

THERE is danger in attributing all sorts of powers, human, superhuman and fabulous, to the computer. Laymen, abetted by the popular press, have some excuse for indulging the habit, but men who claim the title of scientist surely have a duty to discourage it.

The danger is not that the powers of the computer are being overestimated but that the powers of man are being continually degraded. Because a computer can perform mathematical calculations far more rapidly than the human brain is no reason to attribute to it a superhuman intellect.

Some scientists claim that the computer has revealed deficiencies in elementary intellectual techniques. The eminent mathematician who asserts that the computer taught him 'respect for detail' is a flagrant example. A similar claim is made in the realm of linguistics. While it is true that the comparative inflexibility of the computer compels grammarians to break down language structure to its simplest forms, this is no more a scientific discovery than the limitation of vocabulary imposed on the author of textbooks for infants.

Dr Andrew Booth's article in this issue is actually a corrective to this romanticism; but it does tend to suggest that the exigencies of machine translation have introduced the idea of a dictionary of stems. In fact linguists have long been familiar with dictionaries incorporating this system: an example is the lexicography of the Bantu languages of Africa, in which nouns inflect prefixally.

Claims are now being made that computers can 'think' and 'learn.' The so-called learning is far more remote from human learning and thinking than are the conditioned reflexes demonstrated by Pavlov on dogs. Nobody seriously attributes intellectual excellence to the canine world. Talk of machines with 'emotions' is several degrees sillier.

The difficulty is a semantic one which was already familiar to Aristotle and his forebears. Human language is arbitrary, subtle, highly mutable, dependent upon the interaction of common social experience with private discovery. It has to be drastically modified for use on computers. But for Heaven's sake let us not debase our human intelligence to the same level.

The Operational Research department of the British Iron and Steel Research Association, equipped with a computer, tackles a variety of work for steel firms which varies from operational research calculations to looking into the possible use of a computer for the clerical work of a mill office

Lessons from Steel

by KEITH BEAN

VALUABLE pointers for companies outside as well as in the steel industry have emerged from the work of the British Iron and Steel Research Association's computer applications team, which has a Ferranti Pegasus at Battersea.

In its application to clerical work it has already fathered one big computer installation, in the sense that tenders were called after a BISRA study showed the possibility of large cash savings and fewer staff-recruitment headaches. Its work on data-collection from the production line, on production and machine control and on operational research calculations has been equally individualistic and fruitful.

Since the Pegasus was installed in October 1957 it has worked five days a week, six and a half hours a day, with breakdown time loss between five and six percent. Although it is primarily for BISRA work, several member companies hire it regularly, a variety of programming contracts have been fulfilled and it is used for training and demonstrations. Both BISRA and member companies have employed its programmes for general-purpose multiple-regression analysis and analysis of variance. Technical calculations have ranged from the evaluation of production and cost returns to investigations on the highly specialised esoterica of the steel industry.

One job of the computer applications section at Battersea began when Dorman Long (Steel) Ltd., expanding its steel rolling mills at Cleveland and Lackenby and finding it increasingly difficult to get reliable young clerks for the mill order office, asked for a study of the feasibility and economics of using a computer. BISRA completed the study which became the basis for tenders Dorman Long is now considering.

LOGICAL SYSTEM

The work envisaged fell into seven stages which are basic to any system and, being extremely logical, were not thought to call for drastic initial re-designing for computer application. These events were: (1) acceptance and allocation of orders, (2) issue of instructions to the works, (3) progressing production line information, (4) issue of advice notes and invoices, (5) dealing with management amendments, (6) answering enquiries for management and customers, and (7) issuing statistical returns.

A computer was postulated with auxiliary storage—because the order book is so large—and

Although primarily installed for the Association's own research work, BISRA's machine has been used on a service basis by a number of steel companies

two 150-line-a-minute printers to avoid a bottleneck in the large volume of information sheets, advice notes, invoices and other documentation. Here is how it would work:

Rolling mill schedules for three months ahead specify dates and times at which specific sections of steels will be rolled and these would go on the *Schedule* tape.

Customers' period contracts state over-all quantities of steel to be supplied, terms of payment, methods of delivery, advice notes, invoices, marking and other details, and when a customer later places a specific order it will normally only be supplied if his contract already covers it. The contract details go on the *Customer* tape.

Each order would be transcribed to the *Incoming Orders* tape which would be introduced to the computer to ascertain whether a contract of sufficient size was outstanding. If so, details of order number and tonnages would be entered on the Schedule tape at times when the required sections of steel were due to be rolled.

At the same time the computer would produce through the printer appropriate notices to the customer informing him whether his order could be accepted and, if accepted, approximate delivery dates.

Also, as the Incoming Orders tape is processed, accepted orders would go on a composite *Order* tape, a magnetic tape replacement of the present order book.

MILL INSTRUCTIONS

Once a week the computer would use the Schedule tape to produce from the Order tape a further tape, the *Working* tape, which would be used to print out the information sheets which comprise the production instructions to the mill.

Progress of production, reported on sawmen's, straighteners', loaders' and weighbridge reports, would go on tape to check with the Working tape that the correct bars of steel had been cut, for instance, and to note, on the Working tape, completed production and other details.

Once a day the computer would examine the Working tape to see which orders had been despatched and to prepare consignment notes, advice notes and invoices by reference to the Customer tape.

Periodically, completed orders would be deleted from the Order tape and transferred to specially indexed storage tapes. A year's storage tapes can be held in a space of less than a cubic foot.

Alterations to the rolling mill's schedule would

be put on tape which would be used to amend the Schedule tape and the Order tape, with the computer producing notices to customers telling of any alterations to delivery dates and so on.

'Several British computer systems on the market have the characteristics we postulated,' said Mr R G Massey who heads the graduate staff of ten in the computer applications section of BISRA's Operational Research Department, 'and the complete installation may cost £200,000. If this is depreciated over five years—though in practice its useful life will be much longer—the annual charge, with interest, would be between £40,000 and £50,000. Offset against annual running costs of about £5,000 would be a saving of some 140 staff. The net gain would be between £30,000 and £40,000 for the first five years and about £75,000 a year thereafter.

'Apart from the monetary savings, the computer would maintain a tighter control on production and, by making it easier to single out items which required immediate attention, should improve the effectiveness of management.'

INFORMATION FEED

To achieve the best use of such a system as that worked out for Dorman Long, an automatic information feed from the production line was desirable to cut out the necessity for an operator to punch up the information on tape before it went into the computer.

BISRA therefore developed what it calls the Tallimarker system and built a demonstration model of it at its Battersea laboratories.

Connected to a set of uniselectors, rotary or trip switches at various points send each new piece of information to be added to that already stored, allowing for the rejection of the steel ingots or blooms at any stage. The stored information is available for display or automatic recording, or both, at later work points on the production line and in the office. As the rolled steel sections reach the saw and are cut to the lengths required, all the appropriate details are sent to the mill office and to the cooling-bank operator to help him in the sorting of the cut bars for delivery.

Obviously there are many other applications for which the Tallimarker principle is suitable, and not only in the steel industry.

CUTTING WASTE

Again, there are wider, analogous applications implicit in another study which the Battersea team has completed in the cause of taming the variables to reduce waste and increase profits.

Rolled steel sections are cut to lengths which vary greatly both as between customers' orders and within any given order. At present the sawman decides which length to cut next and part of his skill lies in so arranging the sequence that the wasted odd bits at the ends of the sections are no bigger than they need be. He aims to cut waste to a minimum without starting too many orders and thereby creating a mess to be sorted out at the delivery end.

The BISRA experts found that in one particular mill the usable section wasted is nearly two percent and they reported:

'The original programme written for the Pegasus machine showed that this could be reduced to 0.5 percent if a computer were used. In this programme bars to be cut were selected from the next hundred bars on the list. This programme now has been modified so that the selection is made from the next few orders; it appears that selections can be made in the time available which lead to even less waste than with the previous programme.

'An increase of at least one per cent in yield might be possible if a computer were introduced into the mill. In a large mill this would be sufficient to pay for a special-purpose computer costing £40,000 to £50,000 within twelve to eighteen months. It is hoped that a special-purpose machine might cost substantially less than this, although extreme reliability of working would be required.'

Putting it another way, they estimated that a saving of £50,000 a year could be possible using, for greater continuous reliability, two computers at an installed cost of £35,000 each, depreciated over five years.

O R CALCULATIONS

Operational research calculations have meant a number of 'Monte Carlo' simulations for the Pegasus. The computer has made it possible, for instance, to 'create' the operation of a port. About forty different unloading arrangements and different fleet sizes have been simulated for periods of about four years. Telescoping time, the computer takes about two hours on each run.

Problem concerned facilities to be provided in an existing port for unloading ore for a new steelworks to be erected nearby. A large amount of berthing facilities and unloading equipment would ensure minimum turn-round times of ships, to the advantage of the shipowners, but this would result in poor utilisation of equipment, to the disadvantage

of the port operators. Inadequate port facilities would lead to serious delays to ships although a high utilisation of equipment would be achieved.

A correct compromise for most economical operation was required and it was desired to find how this amount varies with such factors as:

i the annual tonnage of iron ore to be imported (since the capacity of the steelworks was expected to increase considerably),

ii the number of berths available,

iii the average unloading rate per berth,

iv the effect of fleets of ships of different sizes (the average size of ore carrier being built is increasing),

v the effect of working (a) 11 shifts a week as at present and (b) 21 shifts a week,

vi under v(a) the effect of using overtime working, and

vii the introduction of priority berthing rules (eg, largest ships first).

In addition the effects of changes in the pattern (distribution) of ship arrivals and of unloading rates on the 'stability' of the solution were to be considered.

Mathematical queueing theory could not be used to investigate such complex factors and their interdependence, and it was thus necessary to resort to the more tedious method of simulation. About 40 different sets of conditions were chosen for study and to carry this out by hand would have been well-nigh impossible.

The work was therefore programmed for the Pegasus, which took about two months, and the trials were then completed in a further month.

The programme was designed to form a representation or 'model' of the port and its facilities within the computer. This model was then 'worked' to simulate actual operations. This was done by 'scanning' all the possible activities of the port at unit time intervals (which represented a half-hour of operation). For instance, at the time when a ship was assumed to have just arrived at the outer harbour, the time which was to elapse before the arrival of the next ship was picked at random from a distribution of inter-arrival times previously stored in the computer. Each successive scan through the port reduced this time by one unit (half-hour) until it became zero when this next ship was assumed to have arrived and the process was repeated.

If the ship arrived during a working shift and if there was a free berth, it would be berthed immedi-

Tapes for the computer are prepared on a Creed tape-punching machine which also prints out 'hard' copy of the input data

ately and unloading would commence. Otherwise it would be delayed in the outer harbour and the delay time would be recorded.

The unloading time for the ship was calculated from the ship size and the unloading rate for this ship, both of which were sampled at random from distributions stored within the computer. The remaining unloading time was reduced by one unit each scan during a working shift but not during an idle shift.

When the remaining unloading time became zero the ship was assumed to leave the berth and its turn-round time could be calculated. The berth was then free to take another ship if one or more were waiting in the outer harbour.

Results were printed automatically at the completion of each year of simulated time (about half to three-quarters of an hour of computer time). These showed: (1) utilisation of each berth, (2) number of ships of each size unloaded, (3) average unloading time for each size of ship, (4) average turn-round time for each size of ship, (5) average delay for each size of ship, (6) number of times overtime was worked, and (7) number of hours overtime worked.

ELIMINATING PAPER WORK

Looking to the future, Mr Massey said:

'The successful use of computers for many of the clerical processes of the steel industry will be dependent on a satisfactory solution of the problems of information flow between the computer office and the production line. At present this flow from office to works and back is maintained by transfer of works documents but unfortunately, at present at any rate, such documents need to be transcribed on to punched cards or tape for input to a computer. This process inevitably introduces delays and a small proportion of errors and if close control of the production line is to be achieved these drawbacks must be resolved.

'The problem is eased by the growing use of automation in the industry whereby automatic instruments are used to control what have previously been manually operated processes — eg, programmed control of rolling mills, push-button control of saw benches, and so on—and by the development of automatic recording devices such as the Performance Recorder and the Tallimarker.

'It thus becomes possible to imagine a steel works of the future in which there is no flow of paper work within the works at all. Operators requiring information would be given it at the correct time by visual displays and the results of their action would be recorded automatically in a form suitable for direct input to the computer. A much closer control of production would thus become possible and in addition accurate instrument readings would be available for statistical analysis which could lead to the design of more efficient processes.'

Considering the operation of a plate mill producing ship plate and the like, Mr Massey gave this step-by-step example:

- i the planning of soaking pit occupancy would be carried out by computer which would signal the next ingot to be drawn and rolled;
- ii on reaching the slabbing mill the ingot would be rolled to the predetermined slab size by the automatic selection of the correct roll pass schedule;
- iii at the plate mill, the operators would be given a visual display of the thickness required;
- iv at the cutting up point, the operators would be given a visual display of the method of cutting up required;
- v a record would be built up successively of the history of each plate produced which would then be automatically recorded;
- vi if at any point the output was not that specified by the controlling computer — eg, if the thickness achieved at the plate mill differed from the specification—this information would be signalled to the computer (by push buttons) and the subsequent production plan would be altered immediately and the best use made of the material.

by ERROLL WILMOT

'Specialisation is an accepted feature of management, as it is an accepted feature of scientific research. But if it is a necessity, where and who are the super-managers to manage the managers?'

MANAGEMENT —BY MEN OR MECHANICAL MORONS?

THE accelerated mechanisation of commerce and industry carries with it a complicated set of human problems. This is a truism, but there is little evidence of serious and systematic attempts to analyse the problems in terms appropriate to their complexity and rapid mutability.

The annual conference of the Office Management Association, which was held at Scarborough during the last weekend in May, was an obvious challenge to the delegates to discuss this vital subject. The title of the conference was 'Trends and Techniques', and the subjects for discussion included 'organisation and methods,' 'work measurement' and 'integrated data processing.'

It was as chairman of the 'session' on data processing that Mr D S Greensmith read out a statement in the name of the Office Management Association reproaching the authors of 'ill-informed' comments on the impact of automatic data processing upon clerical workers. The Association had 'not been able to discover a single clerical worker who has been made redundant and actually lost his or her job with a company as a direct result of a computer being installed.' Problems of 'displacement and retraining' were, however, acknowledged; and the statement concluded that 'the difficulties of changeover must not be underestimated. Success will demand effective man management as well as technical skill.'

CHALLENGE NOT FACED

The emphasis put upon the internal staff problems posed by the technical requirements of automatic data processing makes clear that the real challenge to 'management' is not being faced and is possibly not yet recognised.

Of the fourteen speakers who addressed the conference on specified subjects, Mr J S Cleaver,

who spoke on 'work measurement,' dealt most directly with the impact of modern methods upon the human beings employed in offices. It cannot be assumed that the practices that suit the office of which he is manager are necessarily applicable to, or desirable in, other offices; but some of his observations are clearly worth more than a passing nod of recognition. Declaring that work measurement was as essential in the modern office as in the factory, he said: 'But the essential is great flexibility of staff.' One of the obvious effects of automation is to increase the pressure towards ever more extreme specialisation. It is not necessary to look further than the advertisements of office vacancies in the evening newspapers for confirmation of this trend. Mr Cleaver's insistence upon 'flexibility' is therefore significant.

Specialisation in commerce and industry—as distinct from academic and scientific specialisation —has been largely provoked by mechanisation; but having received, so to speak, an initial impetus, it has been pushed along, in some cases to absurd lengths, by something that begins to look suspiciously like a cult. It is not many years since Charlie Chaplin made satiric fun of the boredom induced by monotonous tasks; and other commentators and thinkers, perhaps more profound, perhaps less entertaining, have tried from time to time to remind us of our humanity.

Specialisation affects people at all levels in commerce, and in this respect it faithfully reflects the pattern of contemporary life throughout the nation. It is more pronounced in very big organisations than in smaller companies, where the switchboard operator may also be the postal clerk and relief typist, and where, perhaps, the managing director may also be sales director and production manager.

NARROWING OF INTEREST

The narrowing of responsibility and interest that has followed mechanisation in factories has, with the advance of automation and its concomitant mass production, for some time been attacking the occupants of executive posts. Mr O J Linforth, manager of the Organisation and Methods Department of Shell-Mex and BP Ltd, said that when his firm created a number of specialist managers they tended to become more and more specialist. The same potential danger existed in the departments of management known as 'organisation and methods,' 'works study,' 'operational research' and so forth. Mr E R Vose, Head of Organisation and Methods of the National Coal Board, also remarked upon the growth of specialisation since the war and noted the 'risk to individual initiative in too much subcontracting of responsibility.' It was necessary, he suggested, to differentiate between the genuine need for specialised knowledge and what was merely a fashion.

If even excessive specialisation (beyond what is a 'genuine need for specialised knowledge') were *merely* a fashion, and thus ephemeral, there would be little cause for worry; but it is not merely a fashion, but to a large extent an irreversible trend, an inevitable symptom of the changing pattern of industry and commerce within a radically changing pattern of society. It is important to recognise this historical fact if we are to be able to talk any sense at all about the impact of automatic data processing upon industry.

PROBLEMS OF DISPLACEMENT

The problems of 'displacement and retraining' of which Mr Greensmith spoke are not by any means the whole problem. It is idle to pretend, as a few people are apt to do, that there is no problem of redundancy—that it solves itself, for example, by 'natural wastage'—but the radical problem lies a good deal deeper than the ejection of a few hundred or a few thousand men and women out of industry onto the slagheaps of idleness. What we have to recognise, with perhaps a spark of prophetic intuition, is the pattern of commercial and industrial society that is being formed.

One problem is this: while the executive decisions necessary in industry become increasingly difficult to make, the training of minds capable of making them is more and more ignored. We are training technical specialists but not capable leaders and makers of policy. The really big decisions tend more and more to be made by chance and desperate men.

THE CENTRAL FEATURE

Not redundancy but dehumanisation is the central feature, the characteristic effect, of mechanical management. The trend towards specialisation is only the mildest of symptoms. We have to recognise that in commerce, in industry, in the whole of 'our' industrial society, the human being as a thinking, rational, decision-making individual is steadily if not rapidly becoming obsolescent. This may be applauded or deplored, according to

temperament; but neither emotional reaction is at the moment relevant. What matters is that the pattern exists and if we are to manage the situation we must first recognise it for what it is.

The multiplication of machines has encouraged the belief that great commercial enterprises could be largely controlled by technicians. The basic defect in this concept is not disguised by the fashion for referring to technicians as 'technologists,' which very few of them are. The increasing complexity of scientific, engineering and other technical processes has led to—it may be 'necessitated,' though the point is debatable—the creation of disparate specialist pockets, each with its own increasingly esoteric language. But the deeper the specialist burrows into his chosen section of his chosen branch of his chosen division of his chosen subject the further does he get from the elevation and the light of day in which he can see human problems, or problems of organisation, whole. He is so small a part of so vast an 'organism' that he is incapable of an objective view. This is a contentious statement, and if it is an exaggeration, the degree of exaggeration varies from case to case, depending upon the size of the organisation and the function and intelligence of the individual specialist.

Now specialisation is an accepted feature of management, as it is an accepted feature of scientific research. But if it is a necessity, where and who are the supermanagers to manage the managers?

THE COMPUTER AS GOD

Automatic data processing, in its most elaborate and highly developed form, is both a product of the trend towards management specialisation and also a significant cause of it. An uneasy feeling that something was happening beyond and independently of human direction, a feeling unfortunately not reinforced by a clear understanding of the process, has given rise to the forlorn though optimistic belief that the technical wonders of the computer and its satellites would somehow solve the problem of management. Hence the jokes, of which the motivation is psychologically significant, about the computer in the role of God. Hence also the first symptoms of the struggle for power expressed as a struggle for control of the computer installation.

The significance of the automatic data processing system as the kernel of management was spasmodically apparent throughout the conference at Scarborough, though, surprisingly, it seemed rarely to be consciously apprehended. When Mr Vose said 'the electronic computer has arrived: we have got to live with it,' just for an instant it was possible to detect, or to think that one detected, a note of despondency or at least of resignation in his voice. 'We have seen the remorseless relegation of craftsmanship in the advance of mass production in the factory,' he said. 'Must office management emulate the grosser and less desirable features of the factory?'

DISRUPTIONS INEVITABLE

The question seems pertinent. Commercial organisations, under the impact of various forms of automation which businessmen in general do not well understand, and the implications of which technicians perhaps understand still less, are bound to suffer the disruptions consequent upon the anxieties and feelings of frustration of their employees. No superficial panaceas prescribed by 'personnel managers' will magically dissolve these difficulties; and those directors, managers and other executives who are at present congratulating themselves on the equanimity with which their subordinates are accepting automation may later experience rude shocks of disappointment. For much disturbance is inevitable. A revolution is taking place, and while we must all hope that it will be a relatively bloodless one, it is too much to hope that it can take place without casualties.

A commercial firm does not exist as an isolated entity. It is part of a total social pattern and it must take its character from the influences at work within that pattern. The 'less desirable features of the factory' are themselves reflections of some of the less desirable features of social or political evolution. We are living in an era in which the relative importance of the human individual and the social group or mass is undergoing extensive change. (To describe this as a 'less desirable' feature of contemporary life is to introduce a value judgment which obviously lays itself open to contradiction; but the present writer at least unhesitatingly endorses the assumption that the relegation of individual human responsibility to vast conglomerations or corporations is thoroughly undesirable.)

In a recent article in *The Times Review of Industry*, 'Projecting the Corporate Image,' Mr B W Galvin Wright, Publicity Controller of Imperial Chemical

Industries, wrote: 'The public now takes into consideration the reputation of the company, its policies and practices and judges by its actions whether or not it is operating in the public interest.

'Part of the total "personality" of the brand . . . is the corporate character of the company behind the brand, and an essential part of the selling operation nowadays is the projection of the corporate image. This process is generally known in industry as Public Relations . . .'

The big corporation depends for its expansion, in competition with other big corporations, upon a combination of automation and specialisation. Automation and specialisation in their turn impose the necessity for perpetual expansion; hence one of the characteristics of industry today is the prevalence of take-over bids in which the most powerful of the big corporations attempt to swallow their rivals. In the United States an attempt has been made to control the growth and limit the power of huge monopolistic corporations; and this amounts to recognition of the social dangers inherent in them.

LOSS OF VOLITION

What has not yet attracted attention or comment is the degree to which the power exercised by huge commercial organisations is independent of human volition. A pattern of behaviour is imposed upon the organisation by commercial and economic conditions, including the conditions of automation and the changes that it effects in commercial society, for which no human decision can be held responsible. In other words there has emerged in our society a situation in which, to some degree, control has passed out of human hands into the orbit of the machine. To an extent that has remained, I believe, almost totally unsuspected, vital and far-reaching decisions in business are being made not by human will but by a complex set of conditions imposed by an economic situation which is created by the spread of automation.

This usurpation of human responsibility is reflected in Mr Galvin Wright's emphasis on the corporate image, on the public and public relations, on management and personnel. There is no mention of people. The traditional personal relationship between the firm and its customers has been replaced by the impersonal relationship between the corporation and its public.

This change in relationship is implicitly acknowledged in the emphasis nowadays given by the publicity and advertising directors of big corporations to 'personalisation.' It is even common practice in all large commercial companies to undertake elaborate 'direct mail' advertising, using skilfully simulated 'personal' letters, which cannot deceive even the least sophisticated recipients, yet make a sort of obeisance to traditional prejudices. We recognise, on the one hand, the reluctance of human beings to surrender their individuality and, on the other hand, the imperative pressures of modern economics, population growth, mass production for a mass market, mechanisation, automation, etc, all of which are hostile to the survival of the individual personality.

HISTORICAL LANDMARK

This, broadly, is the situation as it has been developing for some time, increasingly rapidly in the past three decades. In the light of this situation, the development of techniques of automatic data processing assumes an importance comparable to Rutherford's discovery of atomic fission, the invention of the wheel, or man's discovery of fire: it is one of the major landmarks in human history. It will do more to change the pattern of human society than any other historical event of this century. It is small wonder that commerce approaches it with conflicting feelings of enthusiasm and distrust. It is a contemporary cliché that man's technical inventiveness has outstripped his moral sense or his political imagination. Because the electronic computer is a striking illustration of this maxim it is also a most powerful challenge to man to reassert his sovereignty. If anyone doubts that men will allow themselves to be governed by a machine, let him reflect for a moment how much of his own life is ruled by an alarm clock, automatic traffic signals, escalators, telephone bells and the like. What is less readily appreciated is the degree to which people surrender their own volition to such auxiliaries: how much 'responsibility,' for example, is assumed by the traffic light, to relieve the car driver of volition.

The computer will act in an analogous way in the commercial organisation. It will relieve the executive of the responsibility to watch the side turnings and the intersections and, in theory, will leave him free to concentrate on the road ahead. It will enable him to get along faster—on the main route, the mapped route, the signposted and signalled route. It will not encourage exploration nor inventiveness nor imagination. The pressure to conform to rule or pattern will be stronger than ever.

THE CHALLENGE

This, *mutatis mutandis*, seems to me a fair statement of the sort of challenge that automatic data processing makes to commerce. It is the sort of challenge that already exists in a highly organised society in which there is a marked tendency towards big combines and mass techniques. Already the situation tends to favour the mediocre, the timid and the excessively orthodox. The computer, in its present comparatively crude stage of development, increases this tendency. By its nature it compels uniformity, it permits only limited variability from the norm, it epitomises the moronic enslavement to the rule of thumb. It is indeed its moronic inflexibility that commends it in commercial applications. It also, however, works at speeds far in excess of human capabilities, and it is this feature that makes it a weapon of tremendous potency in commerce. For it makes it possible to plan and carry out industrial and mercantile schemes on a very large scale. But, obviously, the power and responsibility in the hands of the planner, the director of the industrial or commercial enterprise, are enormous.

Manifestly, then, the problem that poses itself for our solution is the maintenance of social and commercial patterns of power and responsibility that are essentially beneficent; and in effect, I submit, this implies the acceptance of an enlightened aristocracy of management, subject to the ultimate restraint and control of a healthy political democracy. The alternative is a jungle tyranny dominated by mechanical morons.

BOOK REVIEW

L Landon Goodman
Automation Today and Tomorrow. A technical survey of current progress. With a bibliography of the automatic factory.
Iota Services Ltd. Distributed by Newman Neame Ltd. 40s.

This is an unsatisfactory book. It is in fact two books bound together: Mr Goodman's 'technical survey' occupies 117 pages, and a bibliography compiled by Iota Services Ltd occupies a further 143 pages. The bibliography is sensibly and usefully classified in sections under chapter headings.

Mr Landon Goodman's survey is prefaced by a quotation from John Stuart Mill, which includes this sentence: 'Human nature is not a machine to be built after a model, and set to do exactly the work prescribed for it, but a tree, which requires to grow and develop itself on all sides, according to the tendency of the inward forces which make it a living thing.'

The reader is entitled to assume that this quotation, unless it is offered merely as evidence of Mr Goodman's erudition, provides a text upon which the argument of the book has some bearing, whether the intention be to refute or to endorse it; but it is quite impossible to deduce, from the large number of apparently unrelated observations that occur throughout this book, what Mr Goodman's philosophy of automation is.

For example, on pages 5 and 6 he writes that 'automation can do away with boring, repetitive work and introduce in its place stimulating, challenging and interesting employment,' which is perfectly true, but no more true than the opposite contention that automation can increase the tedium of factory work by putting people onto boring, repetitive work. Everything depends upon the sense, or lack of it, with which industrial society is planned and controlled.

In a discussion of incentives, with which he concludes his chapter on 'Automation and Manpower,' Mr Goodman writes: 'Incentive payments have the effect of increasing the resistance to changes, and worse, they affect outlooks. "Incentives do something to the workers," as one industrial consultant remarked. They certainly do. For they introduce an atmosphere of greed which may lead to a desire to get out of the company the maximum financial gain in return for the minimum effort.'

This is nonsense. The whole point of incentive schemes is that they encourage greater effort by offering reward for work done, not payment for time served. Any reward is of course an incentive of a kind—the shareholder's dividend as much as the worker's wage or the prize for the egg-and-spoon race—and every human society, north, south, east and west is held together by the 'atmosphere of greed' that the system engenders. What on earth did Mr Goodman really mean?

Discussing salesmen, Mr Goodman writes, on page 27: 'Narrow specialisation will not do in the intensely competitive world of automation. A balanced outlook and quick thinking will be needed in all departments. Men need to be given thinking time and to be trained to use it.'

Undoubtedly the cult of specialisation has been overdone, at the cost, I think, of a great deal of intelligence and imagination which British industry very badly needs. What a pity that Mr Goodman did not pursue the argument, weigh the many and complicated pros and cons, and arrive at a rational conclusion. What a pity, indeed, that he did not, in writing this book, occasionally cast his eye back to the sentence from Mill and test his observations against that clearly enunciated principle. It would have been a far better book.

It would be churlish not to acknowledge the evident labour that has gone into compiling a great deal of material; and however inadequate some of the treatment may be, there is a great quantity of useful information to be gleaned from Mr Goodman's 17 chapters.

It is perhaps indicative of the lack of care of which I have complained to note the repeated use of the term 'technological knowledge' where clearly 'technical knowledge' is intended. Also, incidentally, a script, however illegible, does not become, even in the hands of the most skilful stenographer, 'a well-typed manuscript.'

EW

Mechanical Translation and its Implications in Data Processing

THE mechanical translation of language has importance, not only in its own right, but also in commerce and industry, both as a means of improving communication and as a pointer to the use of new techniques in data handling and retrieval. This inter-relation between an essentially non-arithmetical process and a normal calculating machine exhibits an important idea: that many processes, thought to be typical of living organisms, can, upon analysis, be reduced to combinations of simple binary decisions and ordinary arithmetic.

In 1947 the present author first suggested that the storage organ of a digital calculator could be used to hold a dictionary of words and their foreign language equivalents if these were expressed in suitable numerical code, and also that the logical facilities which the machines contained might be suitable for grammatical processing.

EARLY IDEAS

Unfortunately no digital computing machine was available in 1947 and in the period between 1947 and 1951 when the first of the machines became available for normal use, the development of machine translation was restricted merely to ideas. The earliest proposals considered only the use of the computing machine as an automatic dictionary, but, in 1948, Booth and Richens produced several methods, all of which involved greater sophistication in the linguistic and data processing techniques. These ideas were tested in some experiments which used punched card machinery for the translation of several languages on a word-for-word basis and form the basis upon which most subsequent work has been modelled.

The Americans came comparatively late into the field, the two pioneers being Irwin Reifler at the University of Washington and Y Bar-Hillel at the Massachusetts Institute of Technology. Reifler suggested the pre-editor and the post-editor, the former to remove ambiguities in the foreign language text, for which purpose he need have no knowledge of the language into which translation is to be effected; the latter a technical expert in the subject of translation who would resolve ambiguities and attend to the correct technical phrasing of the results of the machine's operations. Generally the post-editor would be the person for whom the translation was intended. We will not dwell further upon either pre- or post-editor, since

Is the era of translation of languages by computers just round the corner? And if so, will the computer do the translator's job efficiently and cheaply?

by ANDREW D BOOTH, DSc, PhD, FInstP

Reifler himself now believes that neither is necessary.

1953 CONFERENCE

In 1953 the Massachusetts Institute of Technology, in conjuction with the Rockefeller Foundation, held the first International Conference on Machine Translation, and the way in which the subject has grown can be seen from the fact that in 1953 about a dozen experts gathered together, whereas today some hundreds might be expected. The discussions of the Conference were inconclusive, but one positive result was the publication of a volume containing an account of all the work which had been done up to that time and a subsidiary outcome was a much publicised experiment which claimed to show translation from Russian into English by means of business computing machines.

In 1955, the Nuffield Foundation made a generous grant to Birkbeck College, University of London, of funds to pursue research in machine translation on a more extensive scale. The first entry of the Russians into the field was revealed in 1956 when I Mukhin of the University of Moscow surprised delegates at the Conference held by the Institution of Electrical Engineers in London by showing translations which he claimed had been produced on a Russian computing machine. Unfortunately there is internal evidence that these results were not produced by a machine, but the methods which were described were certainly applicable, and Russian work has since increased in tempo until at the present time in Leningrad and Moscow there is a team of some hundreds of linguists working on the resolution not only of English into Russian, but also of Hungarian and Chinese.

At present the major centres of research are: in the United States, the University of Washington, Seattle, Georgetown University, and the Massachusetts Institute of Technology; in England, at Birkbeck College and at Cambridge; and in Russia, at Leningrad and Moscow. New papers and reports are being produced almost daily and the subject is in a state of continuous expansion.

TRANSLATION TECHNIQUES

We discuss next some of the techniques which have been used in translation. It is worth dealing with these in some detail because of their implications in the more general field of data processing. The basis of machine translation is, of course, the dictionary. Unfortunately, even a cursory examination of the way in which ordinary dictionaries are constructed shows that they are quite unsuitable for translation by means of a machine. This is chiefly because they are based upon the assumption that a user will have considerable knowledge of the grammar of the foreign language, and that he can reduce inflected word forms to the particular base which is recorded in the dictionary. One elementary example is the Latin word '*amas*,' another the French word '*cherchait*.' Neither will be found in any dictionary. When a human translator attempts to look up these words, he knows that 'amas' is derived from the Latin verb '*amo*' and that 'cherchait' is derived from the French verb '*chercher*'; a machine, however, does not have this prescience.

Two alternatives are available to overcome the difficulty: the first to endow the machine with a knowledge of the structure of the language with which it is dealing, the second to modify the dictionary. Although the first alternative is not impossible, it is rather difficult and it is fortunate that one of the earliest ideas in this subject showed

that, by a simple re-orientation of the dictionary, the problem could be avoided altogether.

DICTIONARY OF STEMS

The basic idea is that instead of entering the infinitives of verbs, nominative singulars of nouns and so on in the dictionary, what should be recorded are the stems of the words. The stem is here defined as the longest segment of a word which is common to the majority of its parts. This qualification, 'the majority of its parts,' is necessary because in the case of irregularly formed words it may be necessary to store several stems or even complete words themselves. Once the notion of storing stems is accepted, the process of looking up a word in a dictionary by means of a computing machine becomes considerably simplified. Numerous processes are possible but they usually involve first coding the foreign language word in terms of numbers, for example, A=01, B=02, C=03 ... Z=26, 'amo' = 011315, and then testing whether the given code number corresponds with successive dictionary word code numbers by seeing whether their difference is zero. With the stem-ending procedure, however, a zero difference is unusual and generally speaking the criterion of match is simply that the result of a subtraction between unknown word and dictionary entry changes sign at that point in the dictionary at which the stem defined in the manner mentioned above is to be found.

We have not time to discuss the minutiæ of dictionary construction, but it may be well to remark that a certain art is needed in constructing and using such a dictionary if stems of one word are not to become confused with larger portions of other words. These problems, however, have been considered in detail and have been shown to be solvable in all cases so far encountered.

When the stem has been subtracted from the foreign language word to be translated, the remainder, called the ending, can be used to give linguistic information. In the early days this information consisted simply of a few grammatical notes, for example '2nd person singular present tense,' in the case of the '*as*' ending of 'amas' mentioned above; more recently, however, the ending has been used in conjunction with a dictionary of endings to give an appropriate suffix and affix to the word translated. For example, with 'amas' the stem dictionary would give '*-lov-*', the ending dictionary the prefix '*thou*' and the suffix '*-est*.'

METHOD OF CONSULTING

The actual way in which words are hunted out in the dictionary is of considerable importance. The earliest programmes stored the dictionary entries in consecutive locations and in ascending order of code number magnitude and compared the foreign language words starting at the beginning of the dictionary with all entries in sequence. On average it is clear that about half the dictionary must be scanned to obtain the meaning of a word selected at random. With quite small dictionaries this may involve considerable time, even on the fastest computers, and with large dictionaries the process is so unwieldy as to be useless. As an example, with a dictionary of 100,000 words some

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In 1946 he took up a Nuffield Fellowship at Birkbeck College, London, and in 1947 spent six months at Princeton, USA, as a Rockefeller Fellow and member of the Institute for Advanced Study. On returning to Britain he initiated the Birkbeck College Electronic Computer Project and in 1954 received the title of Director of the Computation Laboratory, Birkbeck College, and University Reader in Computational Methods. In 1957 Dr Booth was appointed Director of the newly-formed Department of Numerical Automation.

He was awarded the DSc, London, in 1951.

of the fastest modern computers might take ten seconds to find a word chosen at random.

The second approach which was developed was the so-called ' bracketing ' method in which the unknown word is subtracted from an entry half way along the dictionary. If the result of this subtraction is positive, it will be seen that the dictionary equivalent lies in the lower half of the dictionary, if negative in the upper. Suppose the former case, then a comparison is made with a word one quarter of the way along the dictionary and the same criterion is applied.

It will be clear on a little reflection and analysis that for a dictionary of D entries about $\log_2 D$ comparisons are needed. To put this into perspective we may remark that the number of comparisons required for a dictionary of about 100,000 words is 17 and this would take even slow computers only $\frac{1}{4}$ of a second and fast machines a time of the order of 1/1000 of a second. Before leaving the dictionary, it is worth mentioning that the process of sequential hunting through a dictionary which was used in the early experiments is now returning to favour. The reason for this lies in the fact that for very large texts an efficient method of search is first to sort the text into alphabetical word order, numbering the words in accord with their position in the sentences being translated, then to compare all of the words with the dictionary at one pass. Having obtained the meanings and any grammatical notes which are appropriate by this process, the output is then sorted into original text order again and processed as is appropriate. This distinction between methods of search which are appropriate when few words are to be processed and when whole strings of input data are available at the same time is quite typical of two classes of problem which occur in sorting applications in commerce.

WORDS IN CONTEXT

Anyone who has attempted to translate even simple French will be familiar with the fact that a word-for-word translation is generally ludicrous and frequently meaningless, and that only by considering words in conjunction with their environment among other words, that is of syntax, can an adequate translation be made. The problem of using context has been solved by associating with each dictionary word a number of category numbers. One of these category numbers indicates that a word is a noun, pronoun, adjective, verb, and so on. Another category number shows that a word belongs to certain fields of human endeavour. For example, ' scalpel ' has a meaning which is restricted to the biological field, whereas ' nucleus ' spreads over biology, physics, sociology and mathematics. By means of these category numbers and an associated dictionary of structural forms which indicates, for example, that a well formed sentence must have a subject, verb and object, that qualifying words must be correctly associated with the words upon which they act, and so on, it is possible to produce a passably correct rearrangement of text between the source language and its translation.

LEARNING FROM EXPERIENCE

An essential technique in translation is that of learning from experience. Much has been written on the subject of learning machines mostly of a vague and unsatisfactory nature. In the present context, however, it is possible to give a precise meaning to this term, and it is as follows: in processing any text it will be found that many words have multiple meaning, for example the words ' bear,' ' revolution,' ' nucleus,' and so on. As the machine processes the words of a new text, it counts up the number of occurrences of words in the different subject categories.

Ambiguous words will contribute to several categories, but the unambiguous ones which define the subject matter will contribute predominantly to a single category. After some portion of the text has been processed, the machine will learn by the fact of maximum occurrence in one category that all of the alternatives outside this sphere are to be rejected. By this means the quality of translation and the reduction of ambiguity will increase as the text continues to be processed. If this is considered undesirable, however, a blank run can be made in which no translation is attempted but in which the machine fixes upon the subject matter of the paper concerned. This process, however, is dangerous, since if the author changes his field in the middle of the text, the machine will make mistakes.

For this reason we favour firstly an initial indication to the machine of the general subject matter, and secondly the use by the machine of category information to vary its own consciousness of categories as the translation proceeds, so that, for example, if during a paper on nuclear physics the subject changes to the social consequences of strontium 90, the machine after a small period of ambiguity during re-education would change its

internal category indications, so that the sociological words were correctly translated.

EFFECT ON DICTIONARY MAKING

It is worth reiterating that these translation techniques have considerable impact on other fields. For example, it is the opinion of the author, and of many of the more enlightened linguists with whom he has conversed, that the method of dictionary layout adopted for translating machines could well be adopted in the future for dictionaries which are intended for human use, so that once conventional dictionaries are replaced by these new ones, a person relatively unversed in the structure of an unknown language could still make effective use of the dictionary for translation.

COMMERCIAL USES

The detailed techniques of dictionary search have applications in industry and commerce. Where large amounts of information can be collected together and processed, say, at the end of the week, the method of successive comparison of pre-sorted information with an ordered store of facts may well be the appropriate one, but, where information is required randomly and instantaneously, for example in giving a client in a bank the state of his account on demand, then the partitioning method will be more appropriate. Again, the construction of dictionaries from words gives pointers to the way in which files might be constructed. For example, a dictionary or file which is to be partitioned must be arranged strictly in ascending order of numerical or alphabetical magnitude. This is inconvenient if new data are added at any considerable rate and in the latter case straightforward sorting techniques involving comparison with the whole dictionary may be better since in this case it is possible to place new information at the end of that already stored.

We now turn to another aspect of translating machines. It is this: would it be worth setting up a central installation for the translation of a single language? The answer is unequivocally 'no,' although, of course, work on precisely this basis has been carried out in the United States and in Russia for the particular language pair English-Russian. In a country such as England, however, the answer given above seems to be the only possible one, but when the problem of translating between many languages is considered, several other interesting logical factors become important. Suppose that there are n languages, a, b, c, d . . . n, and that it is required to translate bi-directionally between them.

For a long time it was thought that such bi-directional translation would involve the construction of n (n-1) sets of dictionaries and grammatical procedures. The present author in a moment of aberration then suggested that a way of simplifying this requirement would be to invent a meta-language, that is, some intermediate language into which all other languages can be translated and from which translation can be made back to these languages. It can be seen that inserting such a meta-language M, the total number of dictionary and grammatical pairs required for the n language system described above is 2n. Further reflection, however, shows that this is untrue since, by using one of the languages of the original set as a meta-language, the number of language pairs required to be processed becomes reduced to 2n-2. This simple numerical fact, although perhaps a slight over-simplification of the problem, seems to be completely overlooked by a number of workers in this field.

RESULTS ACHIEVED

After so much preliminary talk, the reader will probably be wondering what sort of results have been produced by the researches which we have described. In particular, does a translating machine exist? To which the answer is 'no.' Has language translation been carried out on a machine? To which the answer is 'yes.' Is translation on a machine at present an economical proposition? To which the answer is again 'no.'

Many examples of machine translation could be quoted, but in the present instance we shall give only two which show both the strength and the weakness of the method. The first example was derived from a scientific text for which mechanical translation processes are particularly suited and it is given below:

> '*L'étude des fonctions definies par une équation différentielle dans tout leur domaine d'existence, est un problème dont la solution complète, dans ce cas général, depasse actuellement la puissance de l'analyse. On a cependent obtenue des resultats du plus haut intérêt en se limitant à l'étude des integrales infiniment voisines d'une integrale connue.*'

> 'The study of the functions defined by a differential equation in all their sphere of existence is a problem of which the complete solution, in the general case, surpasses at present the power of analysis. One has nevertheless obtained results of

highest interest while limiting oneself to the study of infinitely adjacent integrals of a known integral.'

The second example of a more literary style is the following:

'*L'homme qui m'a parlé hier est très malade ; il est tombé de son cheval devant sa maison.*'

'The man which did talk to me yesterday is very ill ; he did fall from his horse before his house.'

This shows the process up in a less favourable light.

SPEED OF TRANSLATION

The speed of translation for French at the present time is about 3,000 words per hour, but there is no reason why, in the very near future, it cannot be increased by a factor of between five and ten, even without the construction of special purpose translating machines. Even so it turns out that the price of translation by machine is perhaps £10 per 1,000 words, and this compares unfavourably with the rate for human translation which is about £2 10s. for the same volume of work.

To summarize the discussion and the remarks which we have made, we can conclude first that machine translation has had a considerable impact on linguists by making them consider with more precision the basic structure of their art. Second, that it has contributed ideas on the processing of large collections of information. Sorting and handling techniques developed for machine translation have proved of considerable value for the more general application and, for example, such improbable things as the construction of a concordance or list of distinct words in a foreign language text has suggested methods by which information derived from a business letter can be collated with information contained elsewhere in files. Third, that it has illustrated how machines can, in a rudimentary sense, be made to learn, and finally that it shows how contextual information can be used to produce an improvement in the results of a given process. We have considered this in the context of language translation, but more generally the methods can be applied to the process of deciding the particular meaning of a statement or occurrence in the context of other operations in the same field: for example, the location of a mutilated order or invoice from a file containing all invoices.

The future of machine translation itself is perhaps less rosy. Despite the prestige value of work in this field, it appears to the author unlikely that translating machines will be of practical utility in the commercial and industrial fields for a number of years to come, and although the United States and Russia may seek to use the somewhat inefficient process to ease their manpower problems in the translation of technical material, it does not by any means follow that this would be a rational approach in a more leisurely society such as our own.

CONTRIBUTIONS

The editor invites authoritative and thoughtful contributions on all aspects of automatic data processing. Factual accounts of first-hand experience in planning, installing and operating computer systems are particularly invited; but theories and prognostications based on practical experience in commerce, industry and government are also welcome.

Articles, preferably between 2,000 and 3,000 words in length, are most acceptable when typed with double spaced lines on plain quarto paper. They should be addressed to:

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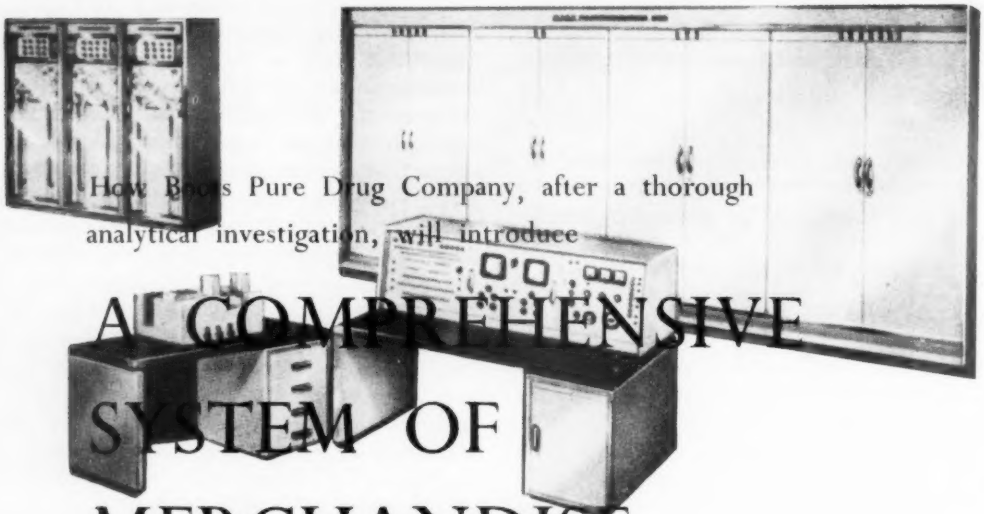


How Boots Pure Drug Company, after a thorough analytical investigation, will introduce

A COMPREHENSIVE SYSTEM OF MERCHANDISE ACCOUNTING

. . . which would operate automatically from the time the retail branch manager ordered replacements of stocks sold, and will provide instructions to warehouses and information to the company's buyers as well as the relevant accounting

by J G THOMPSON, A.C.I.S., M.O.M.A

'SHIFT three left, shift four left, and subtract once—that's quicker than multiplying by 23.' This sort of conversation sounds far removed from accounting of any kind, but is an actual quotation of a discussion between two computer programmers working on a commercial application. But how is such a mathematical statement related to merchandise accounting? What is 'merchandise accounting' anyway? It's an interesting story: let's start at the beginning.

Early Beginnings

It was some five years ago that a small high-level team set to work for Boots Pure Drug Co Ltd to make a preliminary study of the computer market and the possible application of computers to the company's clerical work. Some idea of the scope of that work and of its relationship to the company as a whole can be gained from the charts in Figures 1 and 2 (see pages 26 and 28).

The team's recommendation was that first a small computer should be purchased to be used for payroll, since this was an application which could be considered on its own. It was estimated that the proposed system would be more economic than the existing method, and that valuable experience would be gained in the development of computer techniques. Later events, however, caused the proposition to develop uneconomical aspects. Delivery dates slipped back, and the timing of the project was so delayed that it would have been impossible to gain experience for the

wider plans put forward by the team for future consideration. The scheme was therefore abandoned.

Integration

It had been decided, at an early stage, that one of the major attractions of the large ADP systems being designed in Britain and in the United States was the possibility of integrating large areas of clerical work. In the case of Boots the field for such an operation seemed clear. Procedures were not highly mechanised—no punched card machinery was in use—and yet the majority of the company's clerical work was centralised. Difficulties there would be in an old-established company with a high proportion of long-service employees specialising in well-proven methods, but the fact that the company, in addition to its retail business embracing over 1,300 branches, also owned the wholesale distribution facilities necessary to supply them and a considerable production capacity, made integration seem very attractive indeed.

Start at Point of Sale

Theoretically, the retail, warehousing and manufacturing functions depend, in such a company, upon the passing of goods over a shop counter. Whenever a sale is made, it creates a requirement to replenish branch stock. When branch stock is replenished from warehouse stock, the latter must be made good by an order on a supplier or production unit. In fact, it is often said that the most important place in the company is the 27 inches of counter between an assistant and a customer. This importance is emphasised still more if the movement of information and goods is integrated from that point of sale, because wrong data will transmit errors throughout the whole system.

Equipment designed to record sales accurately has been made in many forms and has undergone extensive trials in America. As yet, there is no firm evidence of success except possibly in the use of micro-punching in tags which can be attached to goods, detached at the time of sale, and used to feed information into a special cash register. Boots' business does not readily lend itself to such a method as the unit sale is small and the inventory is large. Many items are physically small, such as lipsticks, small bottles of tablets, tubes of toothpaste, and in some sections of the business there are many additions and deletions in the inventory from season to season.

It was therefore decided to start one stage farther back along the line of integration—at the point at which an order is created by the branch to replace goods sold—and to devise a system which would provide management information for efficient retailing, warehousing and, eventually, production while fulfilling the daily task of compiling figures for accounting purposes. This area of the company's clerical activities has been named 'merchandise accounting.'

The sales side of the problem, with limited analysis, is to be tackled separately, using specially designed cash registers, an electronic character recognition machine to read the till rolls, and a special-purpose computer to accumulate cash and sales totals. Eventually it is hoped to combine the two jobs into one and to integrate fully merchandise accounting and sales analysis.

Outline of the System

The requirements of the proposed system were:

(1) To accept orders from branches for goods to be supplied from warehouses;

(2) to provide the warehouses with printed details of (a) what to send, (b) where to find it, (c) where to send it, (d) when to send it and (e) how to send it;

(3) to provide the branch with printed, extended and totalled invoices at the time of, or before, the arrival of goods;

(4) to record orders for goods out of stock and supply later without the need for the branch to re-order;

(5) to maintain records in respect of each item in the warehouse for perpetual inventory;

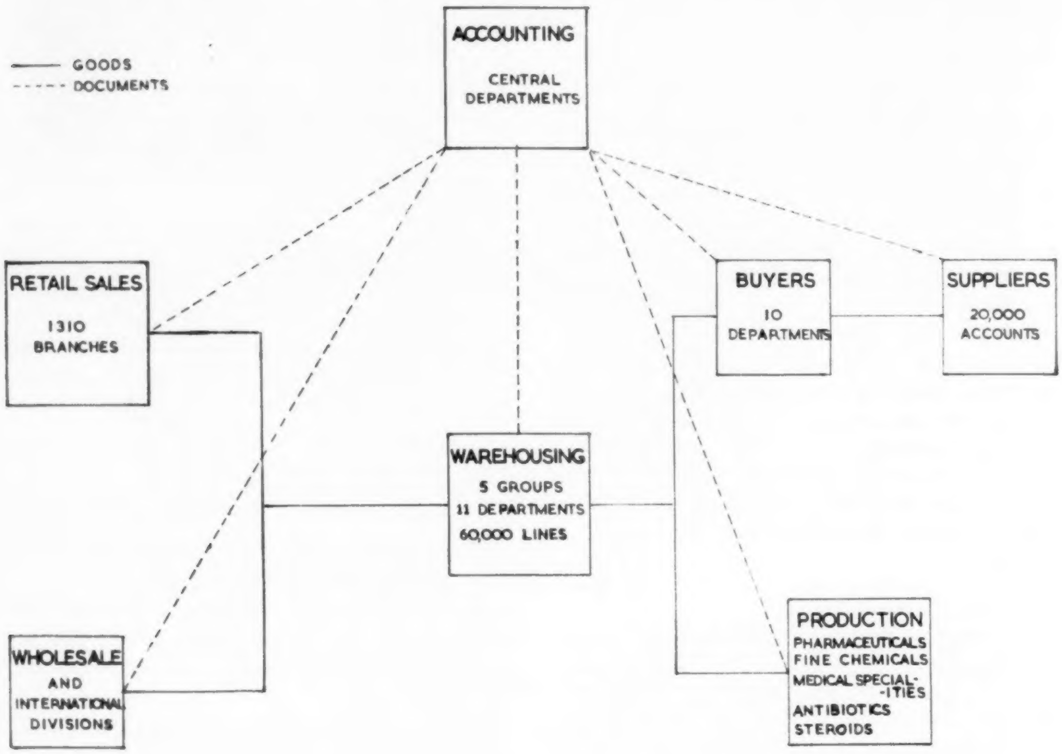
(6) to provide buyers with up-to-the-minute information on stocks and issues; and

(7) to charge goods to branch stock accounts.

Choosing the Machinery

At the time when the preliminary study was being carried out, there was no British automatic data processing system capable of handling an application of this size, involving as it did up to 300,000 order lines on a peak day with an output of more than 350,000 lines of numerical and alphabetical information. A team therefore visited the USA early in 1956 to inspect American equipment and saw as many of their working installations as possible. The result of this visit was the placing of an order in late 1956 for an Elecom 125 system, incorporating an independent

FIGURE 1 **ORGANISATION CHART** (BOOTS PURE DRUG COMPANY LIMITED)



file processor for sorting, merging and selecting units of data. The speed of operation was relatively slow, but this was offset by having a two-in-one system in which the arranging and rearranging of data could take place simultaneously with the calculation and decision-making. Another simultaneous operation was to be carried out by a high-speed offline printer operating at 900 lines per minute from magnetic tape. The Elecom file processor was one of the pioneer fast data sorters using magnetic tape and many more manufacturers are now working in this field. Unfortunately, the Elecom was doomed to an early demise—the Underwood Corporation's expensive venture into large-scale data processing ended early in 1957 when their computer factory was closed and all outstanding orders were cancelled.

This was a heavy blow to the team at Boots who had already put so much work into the project. A fresh start had to be made, and the whole of the computer field was immediately re-surveyed. Quotations from British and American companies were obtained, with estimates of processing time in each case and a basic outline of the programme. Experience in planning for Elecom, for which the programme had been partly written when the order was cancelled, proved very useful in assessing the different methods suggested by the quoting companies.

The final choice fell on the Emidec 1100, designed by EMI Electronics Ltd., but which was still on the drawing-board. Multiple channel input and output and multi-level storage was combined with an unusually high rate of operation. The buffering between the peripheral units and the central computer was very effective in that the computer had access to one-half of the buffer while the input unit was filling the other half—a technique known as 'true buffering' in the USA. Each unit was to be provided with its own dual buffer. Input and output could be by punched tape, punched cards, or magnetic tape, and an additional output facility was to be the newly

developed Samastronic 300-line-a-minute print head. Input/output channels could be ordered as required up to a total of 16. Printing could also be carried out off line from magnetic tape. Storage was designed at three levels—externally on magnetic tape, internally on magnetic drums (up to four to 16,000 words each), and magnetic cores (1,024 words).

The peripheral units chosen for the Boots application were two punched tape readers, five magnetic tape units, one online Samastronic printer, and one tape punch. A further magnetic tape unit and printer were ordered with the necessary conversion facilities for offline printing. Since that time a further input channel has been ordered, using a specially modified card reader.

The reasons for choosing the equipment specified will be clear when considered in relation to the method evolved of supplying the necessary input and providing the required output.

The System in Detail

(1) Branch Orders

Under present arrangements goods are ordered either on handwritten order forms on which quantities and descriptions are entered in full, or on printed order forms on which it is necessary only to write quantities required. Two methods have similarly been specified for use with the computer system. One, for slow-moving lines, will require the writing of an item code and quantity, and the other, for the ' bread-and-butter ' lines, is to use a special system of mark sensing, in which it will be necessary only to record quantities as codes will be generated automatically.

The manual system of ordering calls for the writing of an item code of four letters. Three letters are to define the item, while the fourth is a check letter which depends on the other three. (The letters D, M and U are not used because they are likely to be confused with many other letters.) The incorporation of a check letter is to ensure maximum accuracy in the copying of the code which will often be carried out by junior labour in the branches, and the mathematical formula on which the self-checking feature of the code is based will guarantee the discovery by programme means of all except a small fraction of the most remote and rare types of error. It will be possible for branches to record items on their order forms in any sequence they desire within each of the 11 categories of goods. At head office the orders will be converted to paper tape by Creed punches and checked by Creed verifiers.

The mark sensing system is to use a punched card in conjunction with a special stock book. The card will be lined up with the stock book and the quantity required of any item will be marked on the card in line with the item as printed in the stock book. The number of the stock book page on which the item appears will also be marked at the head of the card. The card will be used on both sides with a capacity of nearly 50 items, and it will be possible to make up to 11 marks in any column of the card to indicate the quantity required. The marking code was chosen after statistically sampling existing order quantities, and it should be possible to indicate nearly all the usual order quantities by one or two marks. The cards will be sent to head office and will be sensed and punched by mark sense reproducers. Initially, the resulting punched cards will be converted to punched tape, but as soon as the special card reader is available they will also be used for direct input to the Emidec system.

In order to handle large numbers of short punched tapes, which will result if the punching load is spread over a number of operators, and to eliminate the tape reader loading time, the two punched tape readers ordered with the Emidec system will be used alternately during the input routine.

(2) Warehouse Details

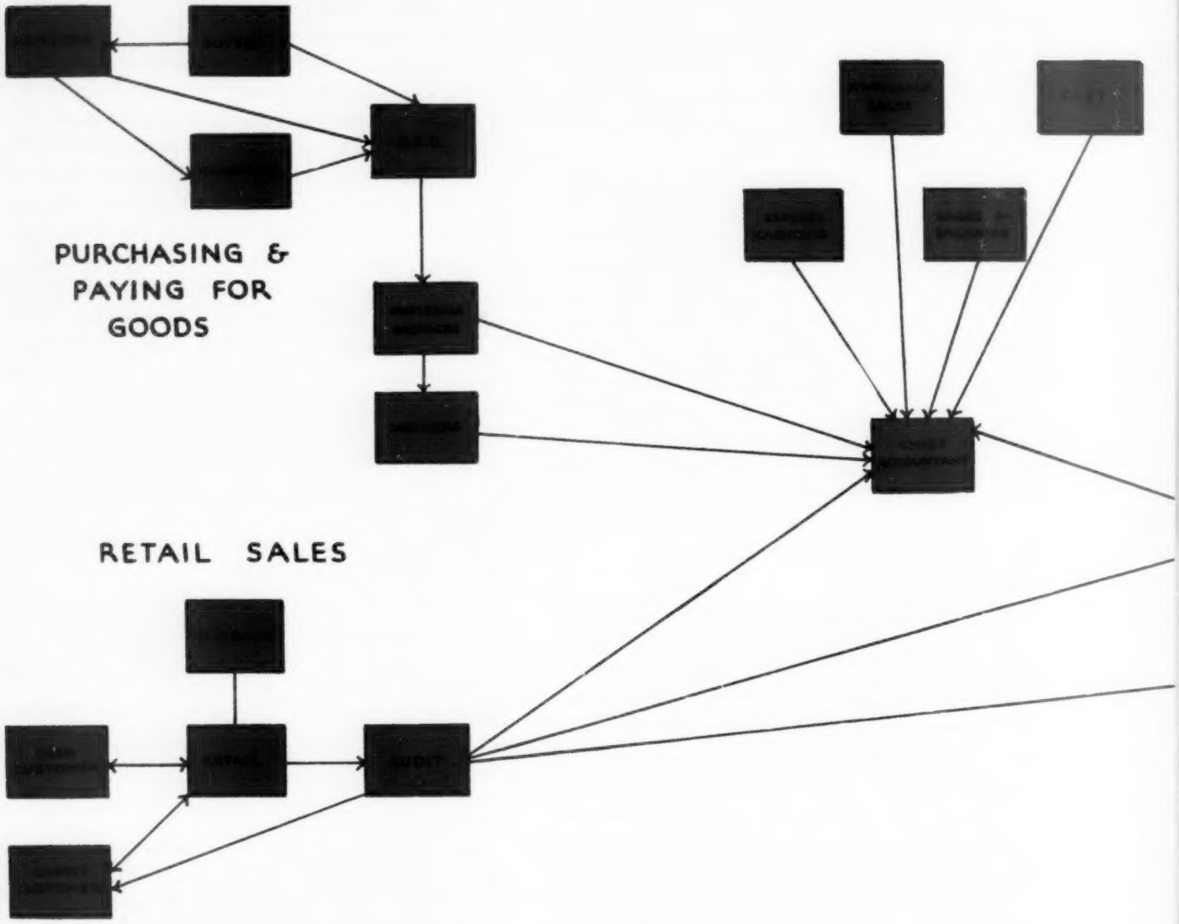
The basis of all computer operations affecting the warehouses is first a master stock file recorded on magnetic tape. There will be approximately 25 items of information about each line in the inventory, including alphabetical description, price, code, warehouse bin number, theoretical stock, appropriations, accumulated issues and receipts. Secondly there will be a despatch and accounts file recorded on magnetic tape containing a list of branches, together with the method of despatch to be used and the day of the fortnightly ordering cycle on which despatch is to take place. Also recorded will be accumulated charges for goods supplied and the current serial number for recording on the invoice.

Information from the master stock file and despatch and accounts file will be stored on the drum at the appropriate stages of the programme.

(a) What to send:

The programme will first check the item code. Once this is accepted, the check letter is of no

FIGURE 2 **MERCHANDISE ACCOUNTING**



further use, and the remaining three letters will suffice to generate the drum address—the storage register where the information concerning the item will be found. Since only 23 letters of the alphabet are used, this is done by multiplying the numerical value of the first letter by 23^2, of the second letter by 23, and adding the value of the third letter. (This brings us to the point at which this article started!) In the case of goods which are supplied in certain minimum quantities, the programme will round up orders for less than these minimum quantities. If the quantity in stock is insufficient to supply the quantity ordered, as much as possible will be supplied, and the remainder recorded on magnetic tape to be despatched when available. If there is no stock, the programme will supply a substitute line, where appropriate, or record the quantity ordered on the 'to follow' magnetic tape.

(b) Where to find it:

It has already been stated that items on manually coded orders from the branch can appear in any sequence. The sequence of the items in the mark sensed card system can be controlled to some extent by the design of the preprinted stock books. In neither case, however, is it certain that the sequence will conform to the arrangement of the goods in bins and racks in the warehouse. The programme will therefore sort the items of each branch order into bin

line will be extended and a total will be printed at the foot of each invoice. On the last invoice of each branch order will be printed the total to date for goods charged during the current month. As the Samastronic print head is 140 characters wide, these invoice despatch notes will be printed two up. A further increase in speed of output will be gained by recording details for two print lines on magnetic tape while the online printer is printing one line. The magnetic tape will be used later for offline printing.

number sequence so that the warehouse will be enabled to assemble them as quickly as possible.

(c), (*d*), (*e*) *Where, when and how to send it:*

These details will be extracted from the despatch and accounts file. The items which have passed through these processes (a) to (e) will be divided into groups for ease of handling. In the case of the first warehouse department to be programmed, the number of items on each despatch document will be 16. The items will be printed out in these groups on despatch notes with alphabetical descriptions for checking correct assembly.

(3) Branch Invoices

A copy of the despatch note will be used as an invoice and advice note for the branch. Each

(4) Orders 'to follow'

An advice of items which cannot be supplied immediately will be sent to the branch as soon as processing is complete. It will be possible to cancel such an item if no longer required. The order will, in any case, be automatically cancelled after the expiry of a predetermined period depending on the type of order.

(5) Perpetual Inventory

The programme will provide for updating theoretical stock quantity, issues and receipts on the master stock file. Any amendments—for example, to correct wrongly reported receipts—will be printed out when processed. All data will therefore be available for reconciling theoretical with actual stock when required. Theoretical stock reports for items of special interest can be printed out when called for.

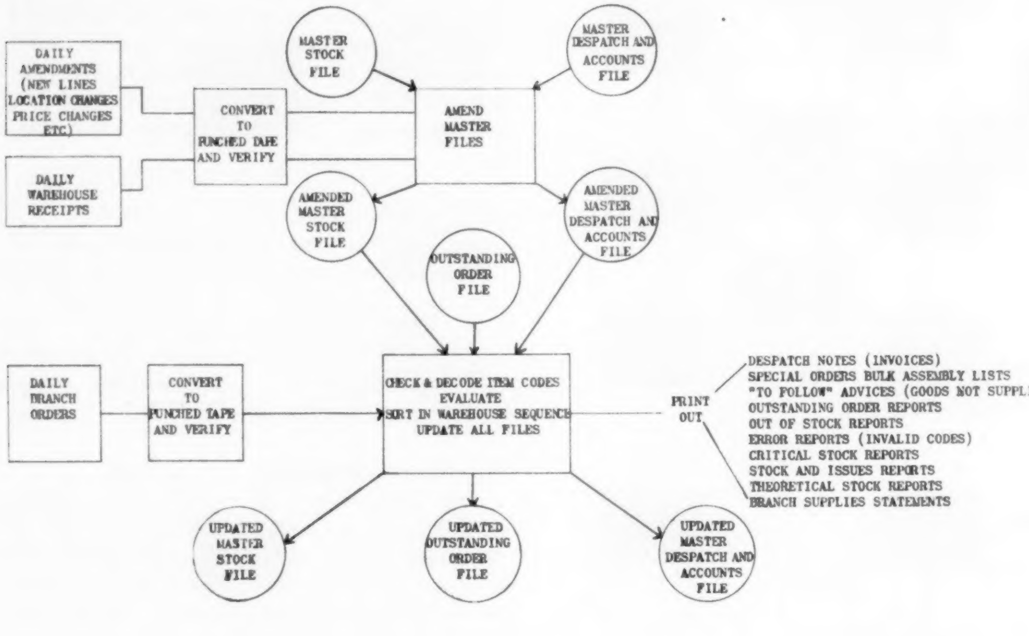
(6) Buyers' Reports

A combined out-of-stock and outstanding order report will be produced daily on the online printer. Items which were not out of stock on the previous day will be identified and details will be teleprinted immediately to the buying office. The printed report listing not only these items but also items which have been out of stock on previous days, will be sent by post. Another daily report will list those items for which the available stock has reached a critical level. Finally, every line in the inventory will appear once per month on a stock and issues report in a sequence required by the buyer. This report will be printed offline since it has no special urgency.

(7) Branch Stock Accounts

The existing system will be used initially and figures supplied by the Emidec system will be merged into it. Adjustments will be made for goods lost in transit or sent in error. The two

FIGURE 3 DATA PROCESSING CENTRE



systems will be merged gradually as the number of warehouse departments whose paper work is processed by the computer method increases. At the end of each month a special programme will print out a notification for the branch of the amount charged to its stock account.

The Programme

Figure 3 shows an outline of the processing sequence. This simple diagram has been supplemented since it was first drawn, about 18 months ago, by three block diagrams, and then about 100 flow charts. The next stage—conversion into individual programme instructions—is about two-thirds completed. In a month or so it is hoped to carry out the first programme test, using the Emidec 1100 now nearing completion at the manufacturers' works.

Test data will be prepared to cover every known contingency, but there is no doubt that in a programme of the complexity required, totalling several thousand instructions, mistakes are bound to occur. Many hours of desk 'debugging' time will be spent for every hour of computer time before a trouble-free run can be expected. Many more hours, days and weeks will be spent in improving the first programme and building in the factors which no one thought of—the odd transaction which looks like a normal one and isn't and only happens a few times every year.

The Future

The programme as at present envisaged starts at the point of ordering and goes on to provide delivery instructions and management information. When experience has been gained and histories accumulated, it may be possible to help management by calculating quantities to be ordered, profit margins and minimum safe stocks. It may also be possible to expand the system to cover branch stocks item by item and submit a pre-calculated order for the branch manager's approval. With a large ADP system, how soon possibilities become probabilities and then achievements is more a question of men than of machines.

Names and Notes

Bull Enters the Arena

THE recently announced new company De La Rue Bull Machines Ltd—established on a fifty-fifty basis by the De La Rue Company and the French Compagnie des Machines Bull—marks the arrival of yet another digital computer firm into the British market.

During the past two or three years, the French company have been expanding their manufacturing facilities in order to extend the scale of their equipment in export markets, and in particular in the British Commonwealth.

Also, the last two years have seen a good deal of preparation for this new venture — the two parent companies have worked closely together on technical projects, notably in the field of automation sorting of documents.

De La Rue Bull will open new offices in Southampton Row, London, in three months' time, where demonstration equipment and a computer service will be established. Staff recruited from De La Rue's personnel have undergone training in Paris during the past year and will form the nucleus of a sales and service team. Dr H Phelps has been appointed general manager of the new company.

The majority of the equipment to be offered by De La Rue Bull is based upon the punched card input system and includes a complete range of card punchers, verifiers, sorters, collators, tabulators, and computers, ranging from comparatively simple electronic calculators to the largest, most complex and most powerful computers yet produced. The essential characteristic of the design of Bull equipment is that all machines are planned so that they can be interconnected. This allows the user to begin with the simplest equipment, consisting of card puncher, sorter and tabulator, adding to it progressively as the training of personnel and the demands of his own business allow. There have already been a number of enquiries from British firms for Bull equipment and as business expands assembly and manufacturing facilities will be gradually introduced into Britain.

The commercial policy of the company will be first to provide service to customers. No commercial proposition will be made to a potential client until his problem has been fully analysed to the point where the full implications of installing automatic equipment are thoroughly appreciated.

The new company will offer a full range of punched card equipment. Left: a Pelerod automatic feed, card-punching machine

The new company will supply specially trained teams for the start-up of each new installation and these teams will remain with the equipment until they are satisfied that the best and fullest use of the machines is being made. From this point onwards, maintenance of the equipment becomes the responsibility of specially trained De La Rue Bull engineers, who will be located on a client's premises in the case of the larger installations.

Instructional classes of a strictly practical nature will be organised for the personnel of clients and it is intended that users of the De La Rue Bull equipment will become associated in a users' club when ideas and practical experience will be exchanged.

The French Bull company is amongst the leaders in the new electronic revolution which is now dominating the scene in France. It was Bull which carried out all the intricate and complicated calculations leading to the designing of the Caravelle airliner, and the latest and largest of its computers, the Gamma 60, has already been ordered by, amongst others, the French railways, the French Electricity Authority, two of the largest French insurance companies and the Telephone Company of Belgium. Since the introduction of the Gamma range of computers in 1952 some 600 of these machines have been sold and they are, at present, being manufactured at the rate of one every two days.

Analogue Machines—Old and New Applications

ANALOGUE computers have been used for some time in the aircraft industry to solve problems connected with, for example, wing flutter and dynamic analysis, and an order by de Havilland Propellers Ltd for a large Emiac II machine—to be used for research into guided missiles and high-speed flight problems—confirms the usefulness of these computers to the aircraft companies.

More unusual is the British Nylon Spinners' analogue computer installation at their Newport factory in Monmouthshire. Installed by Solartron some ten weeks ago, it is to be used to explore new methods of producing and processing man-made fibres. Simulating production and process conditions will obviate the need to build costly pilot plants, or to interfere with the existing production plant. One of its first tasks will be to investigate precise control of yarn tension regulating and spooling—which are vital to the faster, and more economic, running of textile machinery.

The Order Book

LAST month produced a goodly crop of new orders for digital computers. BEA are to put down £250,000 for an Emidec 1100 as a measure of forward planning. To plan flight schedules that are both convenient and operationally efficient, BEA need a deal of information about passenger and freight movements. 'Up to now,' BEA state, 'we have been able to get this sort of information from conventional office systems but our business is increasing at such a rate that we can foresee the time, within a year or two, when more advanced data processing methods will be essential.' However, first jobs to go onto the machine will be revenue accounting and the clerical work connected with inter-airline ticket transfer facilities. Also pinpointed for early mechanisation are BEA's costing and budgetary control operations, purchase-accounting and payroll.

Ultimately, the computer will be used to plan flight schedules and the organisation of other services and so improve the airline's services.

▶ Production control and scheduling will be the principal tasks of the Leo II computer British Oxygen Gases Ltd have ordered. The machine, due to be installed at the company's Edmonton works at the end of the year, will be equipped with magnetic tapes, a large magnetic drum and high-speed printers.

To control and schedule work, the computer will be used to trace, and anticipate, sales trends for 8,000 products ranging from giant oxyplanes to breathing apparatus; calculate production needs by anticipating sales and taking into account known stocks; keep stocks at lowest possible level yet so that they still meet customer requirements; calculate requirements for raw materials; and a host of other jobs to integrate buying, production and sales.

▶ Soon to graduate from punched card equipment to a computer, Crosfield and Calthorp Ltd, manufacturers of animal foodstuffs, first installed card equipment in 1951 to handle invoicing, sales statistics, ledger posting and calculations of agents' commissions. This work will now be done on an ICT 1202 computer which, with ancillary equipment, will cost the firm £50,000.

Continued on page 54

Delegates to the International Conference on Information Processing assembled in the Grand Amphitheatre of the Sorbonne for the opening session of the conference on June 15. UNESCO photo by Claude Bablin

An International Conference on INFORMATION PROCESSING

THE figures of Lavoisier, Descartes and Pascal looked down on the delegates in the great amphitheatre of the Sorbonne at the opening session of the International Conference on Information Processing which was held in Paris from 15th to 20th June. A large proportion of the 1,500 mathematicians and technicians from 36 countries who were attending the conference were present at this opening session and heard the inaugural speeches, emphasising the historic importance of the gathering.

Pascal, surely, would not only have applauded the triumph of mathematics and technology that the conference represented, but would even more readily, perhaps, have endorsed the moral exhortations and warnings that were reiterated in the inaugural speeches, tempering the prevalent mood of congratulatory optimism.

M Hugues Vinel, delivering the inaugural speech on behalf of his chief, M Louis Jacquinot, Minister of State in charge of Scientific Research, spoke of some of the achievements that had been made

possible by the development of the electronic computer—in solving problems of aircraft design, for example—and emphasised the social responsibilities of the scientist and the technician that went with increase of power bestowed by the machine.

M René Maheu, acting Director-General of UNESCO, reminding us that Pascal had invented the first calculating machine, pointed out that 'man's intellectual power has been increased in an extraordinary manner' by the electronic computer; but the machine was an auxiliary, not a substitute for human intelligence, which alone could exercise imagination and creative power.

Professor Howard H Aiken, president of the conference, in reviewing the present uses of computers, gave pride of place to commercial and industrial applications; then, turning to the role of the scientist and technician, he said: 'With opportunity, power and capability comes responsibility. We have responsibility for the application of computer ideas in the public interest and for the benefit of society in general.'

Prolific Revolution

There was a general awareness of the importance and historic gravity of the occasion, even if there were few present who could precisely say what the portents of the occasion were. Their sentiments were probably expressed by the correspondent of *Le Figaro* who wrote: 'Perhaps the historians of the future will say that the famous *cassure du siècle*—about the year 1945—was marked less by the atomic bomb than by this prolific revolution in thought.'

After the formalities and courtesies of the opening session, the business of the conference was transferred to the UNESCO building, where papers were read on 'Methods of Digital Computing,' 'Logical Design of Digital Computers,' 'Common Symbolic Language for Digital Computers,' 'Automatic Translation of Languages' and 'Pattern Recognition and Machine Learning.'

Contributions came from Britain, the United States, France, Italy, Western Germany, the Soviet Union, Japan, the Netherlands, Israel, Switzerland and Czechoslovakia.

Under the auspices of UNESCO, and in association with the International Conference on Information Processing, the exhibition 'Auto-Math 1959' was held in the Grand Palais in the Champs Elysees from 13th to 23rd June.

A general view of the UNESCO building in the Place Fontenoy, Paris, where the conference was held. UNESCO photo by Dominique Lajoux

Among the exhibits at the 'Auto-Math 1959' exhibition in the Grand Palais, Paris, during June, were these two Japanese computers. In the upper photograph is the NEAC-2203 transistorised digital computer manufactured by the Nippon Electric Company, and the lower picture shows the Hitachi Parametron Automatic Computer (Hipac-101), manufactured by Hitachi Ltd

Professor Pierre Auger, Secretary-General of the conference
UNESCO photo by Claude Bablin

This highspeed printer, with driver unit and memory control unit, made by the Oki Electric Industry, was another Japanese exhibit at Auto-Math 1959

Professor Howard H Aiken, president of the International Conference on Information Processing, addressing the delegates at the opening session of the conference, in the Grand Amphitheatre of the Sorbonne
UNESCO photo by Claude Bablin

An article on the Ferranti Perseus computer appeared in the June issue of *Automatic Data Processing.* **This is a sequel to that article and deals with an application of the computer system. Above, the new building of the Trygg Fylgia Insurance Companies which houses the organisation's computer**

An Insurance Company's computer

will keep track of

by P M HUNT

750,000 POLICIES

THE first Ferranti Perseus System, has been ordered by A B Datacentralen) Trygg Fylgia Insurance Companies Group) in Stockholm, was delivered early this year. With their kind permission a description is given in this second article of the manner in which the equipment is to form an integrated electronic data processing system in the office.

The Insurance Stock of Trygg

The stock consists of some 800,000 policies out of which 750,000 are industrial life and 50,000 ordinary life. The application to be described below concerns the 750,000 industrial life policies. The number of premium payments per year per policy is three on average. In former years the company has had the premiums collected by agents, but by the time the computer is installed all payments will be made direct to the head office via the Swedish postal cheque service.

Trygg's ADP Application

It is envisaged that in Trygg automatic data processing will cover the following area:

1
- Premium billing
- Premium collection
- Settlement payments
- Various transactions (i e changes) such as waiver of premium, policy loans, claims, lapses, reinstatements, etc

2
- Surrender value computations
- Dividend computations
- Reserve valuations
- Statistics

3 Policy Issue

4 Commission accounting

In order to be able to carry out this work on the computer a complete description of every policy in force is stored on magnetic tape. This description must contain all the information necessary for the various applications, including name and address of the policy holder for billing purposes, surrender value of the policy, etc.

Each policy is described in 384 characters which comprise an up-to-date description of the policy, giving all particulars relevant to the policy for the present time and the future.

The description of an industrial life policy in 384 characters, which is one Perseus block of 32 words, is shown in fig. 1. The 750,000 policies therefore occupy 750,000 blocks on the magnetic tape (which is approximately 120 reels each 3,000 ft long), and these reels of tape are referred to as the main file of policies or as the main tape.

Updating and Use of Main File

The information on the main tape is kept up to date in the following way. Each month the tape is run through the computer and all alterations which have taken place since last month's processing are fed into the computer and incorporated in the main file. Examples of such alterations are the date the last premium on a policy was paid (which is altered each time a premium is paid), and the premium reserve (which is altered each time the policy has an anniversary).

Alterations are fed into the computer either on punched cards (e g for name and address changes, etc.) or from magnetic tape (e g for the new

FIG. 1

0	Date until which prem. is paid x	1	POLICY NUMBER	
1	NAME			
2	NAME			
3	ADDRESS			
4	ADDRESS			
5	ADDRESS			
6	Mode of payment for Prem. billed	2	Code for printing	PREMIUM BILLED
7	AGENTS' CODE			
8	Date until which billing is stopped x	Stop billing ind.		Prem. and interest for a loan combined with a temp. ins. for same amount.
9	Mode of payment	group	3	LOAN INTEREST
10	Due date x	4		Premium for life insurance (prem. billed minus loan interest)
11	Code for prem. accounting	Surrender value during the current month		Value of the div. during the current month
12	Temporary premium difference to be added to or deducted from the next premium			
13	Date until which waiver is granted	Waiver code	5	Waiver amount
14	Type of policy			
15				
16	6 x	7		Surrender value xx
17	8 x	9		Dividend xx
18	Code for printing cards for the agents' files			Monthly increase of the surrender value
19	LINK	10	11	Monthly increase of the dividend
20	Date of birth 1 x	12	Sex 1	Risk amount for person 1 x
21	Date of birth 2 x	13	Sex 2	Risk amount for person 2 x
22	Commissionable value 1			Reserve x
23	Comissionable value 2			Net Premium
24	Date of issue 1 x		18	Premium for element 1 xxxx
25	Date of issue 2 x	15	19	do. 2
26	14	16	20	do. 3
27	Duration xxx	17	21	do. 4
28	22		27	Face amount for element 1
29	23		28	do. 2
30	24		29	do. 3
31	25	26	30	do. 4

KEY

x **Expressed in number of months from January 1, 1900 (Date of birth for persons born in the 19th century is expressed in the number of months from January 1, 1820).**

xx **Calculated for a duration of N months (N is the next highest even multiple of 12)**

xxx **Every life insurance policy is, for calculations of actuarial values, considered as consisting of at most 4 elements**

1 Billing code
2 Number of months after which a new regular billing is to be made
3 Binary code for change of the policy (used only at changes not in accordance with the original contact)
4 Indication that the policy is to be included on the monthly list of values
5 Percentage of the premiums to be paid by the policy holder (in case of partial disability)
6 Date for change of premium
7 Code for change above
8 Date for a face amount due for payment
9 Code for the payment of above
10 Indication mark for reduced paid-up policy
11 Code for cashing agent (only for premiums cashed through an agent)
12 Date of birth (day of the month) 1
13 Ditto 2
14 Date for change of policy (see 3 above)
15 Risk category
16 Signal for printing
17 Warning indicating that the values on the monthly list may be incorrect
18 Age at issue, element 1
19 Ditto 2
20 Ditto 3
21 Ditto 4
22 Code of the element 1, indicating formulas and mortality tables to be used for calculations
23 Ditto 2
24 Ditto 3
25 Ditto 4
26 Category according to the period of issue
27 Number of years from the issue to the expiration date for element 1 (Term for element 1)
28 Ditto 2
29 Ditto 3
30 Ditto 4

The letters and numbers above refer to the letters and numbers within the diagram.

premium reserve value, which has previously been calculated in a separate run on the computer).

The main tape contains therefore an up-to-date policy record of all policies in force and this tape is used for various different purposes, the most important of which can now be summarised.

If the premium on a policy falls due, then information for the printing of this notice is taken from this main file as it passes through the computer. Reminder notices are also obtained, and for policies for which the premiums have not been paid—even after reminders have been sent to the policy holders—information is taken from the main tape for printing, since these policy holders will need a visit from the agent.

If a policy comes to an end whether this is due to death, maturity or surrender, the insurance sum ('surrender value' in case of surrenders), plus accumulated dividends, has to be paid to the policy holder. In order to do this, up-to-date surrender values and accumulated dividends are kept on the main tape and a list of these is printed every three months. These lists are used when a policy holder inquires about the value of his policy.

In order to carry out this work two main programmes and three subsidiary ones have been devised. These are shown in fig. 2 and will now be described in more detail.

The Administrative Run

Once each month the main tape is passed through the computer and the administrative programme is obeyed. Last month's accumulated changes of various kinds (30,000 to 40,000 transactions) contained on 40,000 punched cards as input medium, are processed and incorporated in the main file.

At the same time 200,000 premium payments are registered from an auxiliary magnetic tape, processed beforehand by means of punched paper tape (7 hole).

For other more intricate changes, it is necessary to process the information in advance and put them on magnetic tape, ready for use in the administrative run. This procedure is used for new policies and for newly calculated surrender values, dividends and reserve values.

During the administrative run certain information is obtained from the main file. For those policies for which a premium is due, a premium notice is prepared from information on the main file and sent to a billing tape; reminder notices are dealt with in the same way. A list of matured policies, changes in Agent's commission due to lapses and reinstatements, etc, are also obtained. Moreover there are two other kinds of output from the administrative run which need extra explanation—the value tape and actuarial tape (see fig. 2).

The value tape contains concentrated information (93 characters) for each policy in which there has been a change in either the administrative or actuarial run.

The information is printed from the tape on a list which will contain condensed information of about 500,000 policies each month. Each policy is written on this tape every third month regardless of any changes to that policy or not. This is to make it possible to keep track of every policy within reasonable bounds. The list is kept as a reference facility and will contain the surrender value and dividend for each policy calculated with regard to the latest premium payment and other information necessary in the clerical work such as premium payment status, waiver of premium, policy loan, etc.

If a policy has its anniversary during the month to come a complete copy of the policy will be taken on a separate tape, called the actuarial tape. Those policies in which a change has just been incorporated on the main file are also copied on the actuarial tape, if the change affects the actuarial treatment of the policy. If the policy holder has just moved to a new house, for example, there will be a change of the address on the main tape but a copy of the policy is not put on the actuarial tape. This means that the computer picks up about one twelfth of the portfolio for an 'actuarial yearly brush-up' in addition to those policies which have to be recalculated on account of some change initiated in the main run.

The Actuarial Run

As a result of the processing according to the administrative programme the actuarial tape is obtained and this is then processed according to the actuarial programme.

In the description of each policy contained on the main tape the following information is kept:

1—A code equal to the ordinal number N of the current year as reckoned from the date of issue. From duration 0 to duration 1 the policy will thus be within year number 0.

2—The surrender values of the policy at the beginning and at the end of year N.

3—The accumulated dividend at the beginning and at the end of year N.

4—The premium reserve of the policy at the end of year N.

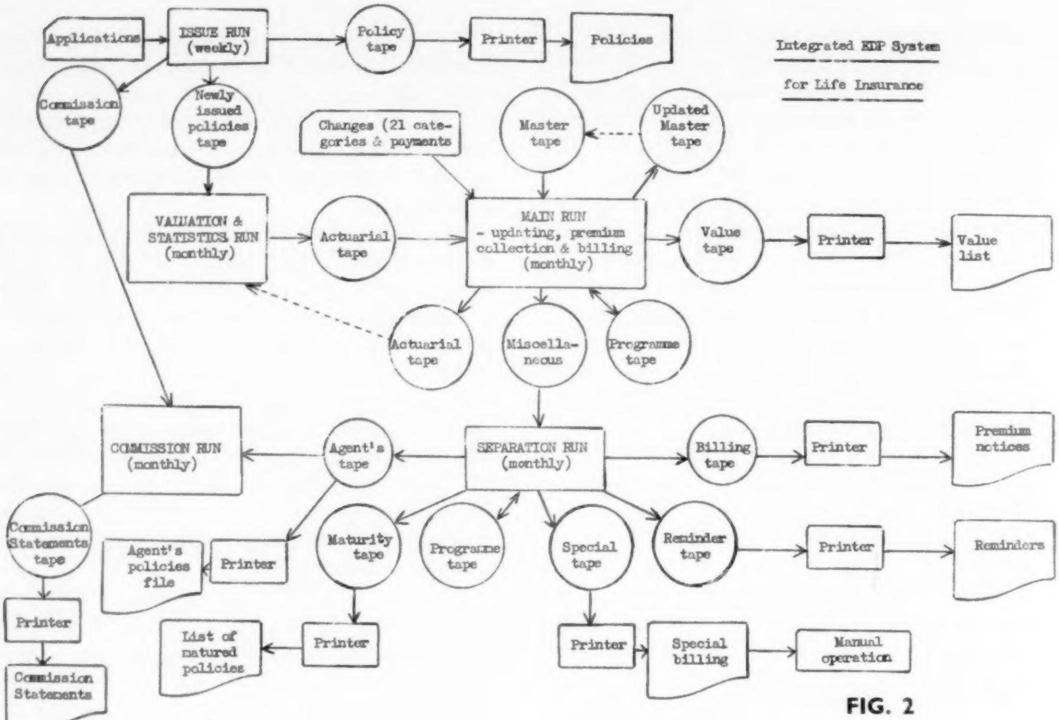


FIG. 2

5—The amount of risk at the end of year N (In the case of a joint life policy the amount of risk is given separately for each of the insured persons.)

The aim of the actuarial programme is to keep these data valid with respect to the current year. Surrender values and other actuarial constants cannot be calculated on a table look-up system because of the vast amount of store required to hold the tables. A past Chief Actuary of Trygg, Mr H Bohman, worked out a new scheme for the calculation of these quantities using formulæ which could be programmed, and he has given an account of this work in a paper to the XVth International Congress of Actuaries in New York 1957 (Volume I, Papers).

Further the actuarial programme also accumulates certain statistics of which some examples are the sum of all premium reserves at the end of the current calendar year, the business in force by plan, the amount of risk in force by attained age, and changes within the business in force by cause of change.

When the outgoing actuarial tape is completed the new surrender values, premium reserve, etc, must be copied from it on the main tape. This will be done during the next month in connection with the processing of the main tape according to the administrative programme. This tape will then make part of these changes which are to be entered on the main tape (fig. 2.)

The Three Subsidiary Runs

In addition to the administrative and actuarial runs there are three subsidiary runs. The separation and editing run is required in order to edit and divide the miscellaneous tape obtained from the administrative run. The tapes derived in this run are shown in fig. 2.

The issue run which is carried out weekly has as its input cards on which applications for new policies have been punched. The computer produces a magnetic tape of new policies which will be used as input in the next actuarial run. A commission tape to be used in computing the agent's commission for the new business is also obtained.

The commission run, which has as its input the output tape from the administrative run containing lapses and reinstatements and also the commission tape from the issue run, produces once a month specifications of issues, reinstatements and lapses per agency and will calculate the agent's commission and prepare bills of payment.

Fig. 2 shows the principal runs of the integrated system. Minor red tape runs are necessary to coordinate the integrated system and there are also some separate statistics runs in the complete picture.

A survey of the United States business world by the Research Department of John Diebold and Associates

Ninety Percent of Computer Users are Satisfied

'The field is so big and is moving so fast, and the immediate outlays and far-reaching expense implications are so great, that the failure to take advantage of qualified, objective professional opinion may be a costly economy.'

THIS report presents the salient results of a survey of users and potential users of automatic data processing equipment, conducted by the Research Department of John Diebold and Associates, Inc. The contacts were made by questionnaire and by personal interview. Approximately 5,000 questionnaires were distributed, and many were followed up by on-the-spot discussions. Some 300 valid replies were received. Somewhat over 55 percent of those responding had computers installed or on order.

While this is not a 'snapshot' picture of practices, inasmuch as initial mailings of the comprehensive questionnaire were made well over a year ago, and follow-up has been carried on for continuing updating since then, it is believed that the information here assembled is revealing of attitudes and practices currently in effect in the United States It was felt that it would be more constructive to extend the survey period over a considerable time, in order to follow up on coverage, than to generalize from the immediate results of an initial mailing.

By and large the results as given here are self-explanatory. The remarks that follow have been divided into five categories—'Pre-computer Conditioning,' 'Planning for the Computer,' 'Operating Practices,' 'Experience with Computers,' and 'Future Plans.' They will provide insights of value to users and potential users in evaluating their own current or contemplated programmes, and to manufacturers of equipment seeking additional perspective on the continually dynamic and expanding electronic computer market.

PRE-COMPUTER CONDITIONING

It is expected that by and large, companies have not gone into full-fledged computer installation without having had some 'preconditioning' in data processing in the form of a punched card system. Approximately 91 percent of the replies reported the use of a punched card system before acquiring a computer. However, among those who have a

computer on order, as compared with the ' older hands ' who have a computer installation now, the percentage with a prior punched card system is somewhat smaller. This reflects the greater opportunity to take the first step in ADP with the smaller and medium sized computers now especially adapted to business data processing.

It is interesting to observe the extent to which the companies that have recently entered the computer market have become known to the business public. The replies indicating familiarity with computers of specific manufacturers showed 98 percent were familiar with IBM, 85 percent with Remington Rand, 74 percent with Burroughs, to about 35 percent or below with Underwood, Alwac, Royal McBee, RCA, Minneapolis Honeywell, Bendix, and Philco. It must be remembered that since the initial contacts, some of these manufacturers have strengthened their positions. In analysing the returns, it was interesting to note that among companies that had ordered or installed equipment, there were some which were familiar with only one company's equipment, and more which had familiarity with only two.

It appears that the predominant influence on the users' and potential users' familiarity with the equipment of various manufacturers is personal appearances, demonstrations and contacts. A combination of sales representatives' calls and discussions at trade associations was the method by which 36 percent of the users and potential users first became familiar with the equipment. However, 17 percent of current and potential users had to make the overture in contacting manufacturers. This indicates a continuing broad need for constructive, aggressive selling.

PLANNING FOR THE COMPUTER

By far most decisions to install a computer are made after a formal feasibility study. It is interesting to note that very significantly more of those with computers on order report such studies, than those with computers already installed. This would indicate that experiences of users, who may have rushed into installations, are convincing potential users of the wisdom of thorough analysis and planning.

It is indicated that those who reported feasibility studies had more than a cursory investigation in mind. Only eight percent recorded such studies as taking under three months, while 70 percent reported studies of six to twelve months or more. Man months of programming prior to arrival of the computer run into sizeable figures. Excluding the significant 19 percent who indicated ' over 168 man months,' the remainder show 30.4 man months average, with a peak in the 24-48 man months range.

Reliance is still placed on a steering committee in planning for ADP. The greatest single title of those heading up such a committee is Controller, while in a significant number of cases (10 percent) the president was reported as participating directly in this way.

Major reasons for choosing a computer were ability to integrate with the present punched card

FIGURE 1

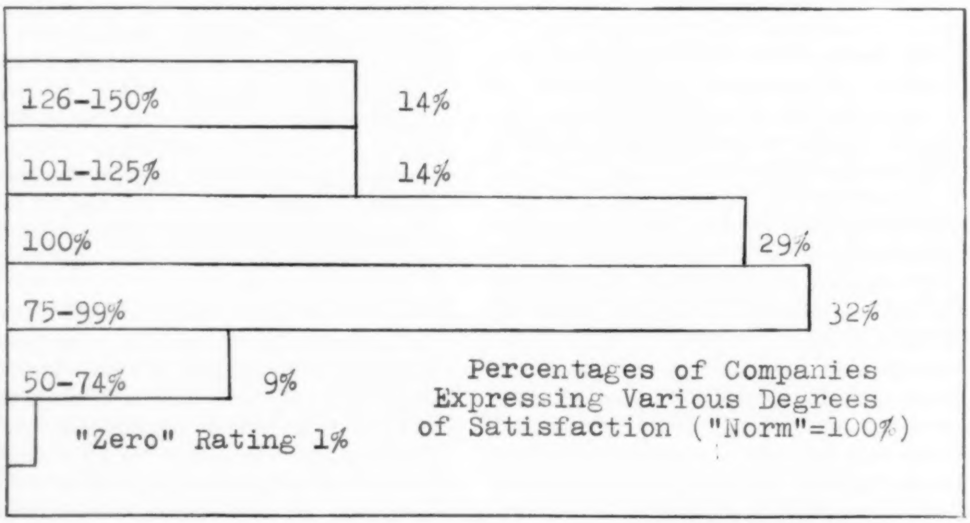
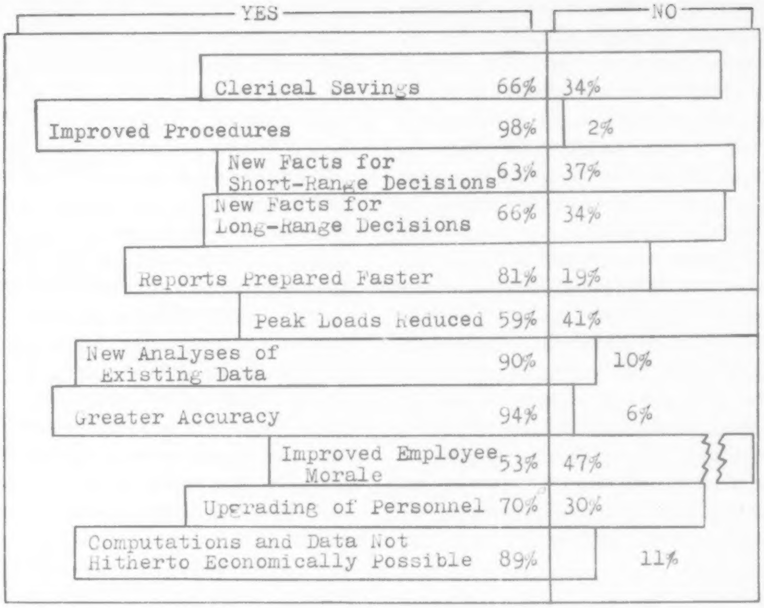


FIGURE II



system and the reputation of the manufacturer. It is interesting to note that price ranks fourth in the weighting of reasons for choosing a specific computer. That delivery date is weighted last out of ten reasons reflects the long planning time involved in conversion.

OPERATING PRACTICES

By far the greatest percentage of computer installations for ADP are centralized. Computer time is heavily used for historical accounting processes, such as payroll, accounts receivable, inventory control, etc. However, it is interesting to note that a sizeable group are devoting from one-third to more than two-thirds of computer time to applications not previously amenable to other than hand processing.

The potential users of computers are somewhat more optimistic about the percentage of ' power on ' time to be attained—expectation is 68 percent, compared with the 56 percent of those who have had six months or more experience with computer operation. It is interesting to note that the debugging time accounts for an important part of this difference. The experienced users have found that debugging time requirements run approximately 17 percent of the ' power on ' time, whereas the on order respondents predict 12 percent debugging time. About half of the companies expect to have surplus computer time, and this is borne out by reports from the companies with computers already installed. In those cases where outside data processing centres are used, the major reason is one-shot problems. Some companies have indicated use of such outside centres for peak load processing and pre-installation education.

The use of automatic programming techniques is widespread, and from all indications such techniques are being improved all the time. Of all the respondents, 91 percent are using automatic programming techniques to some extent.

EXPERIENCE WITH COMPUTERS

The accompanying exhibits show quite a good ' score card ' of how computers are living up to expectations in specific areas. Considering the size of investment involved, the 10 percent indicating a low degree of over-all satisfaction should not be too lightly dismissed. Considering the newness of the whole field of business applications, however, the total picture is good. Figure II shows areas for improvement. Note the biggest ' no '

in improved employee morale. Better use of the computer for decision-making is also a problem. The high satisfaction ratings, coupled with the large percentage reporting negligible clerical savings, and actual clerical cost addition, shows that collateral advantages and additional load are the predominant factors dictating installations. The most important benefits derived from the computer installations were increased speed and reduction of errors.

Some of the weakest aspects of current ADP programmes were pointed up by the survey. By far the greatest is the conversion of raw data, coupled with systems and procedures development. Areas for further improvement are supply of management information, timeliness of results, cost of operation, and flexibility for changing requirements. Linked with these are problem definition, selection and training of personnel, and programming, which were ranked high in the evaluation of difficulties experienced.

FUTURE PLANS

While historical accounting applications will always be an important part of computer use, there are indications of growing interest in using computers for 'management science' problems.

Survey results indicate that users by and large do not expect fast-moving improvements to play a disruptive part in obsoleting the computer of their choice, after feasibility studies have shown justification for it. The majority expect retention of their computer well within the allowed amortisation period for electronic equipment, although those with equipment on lease, of course, consider the obsolescence risk largely borne by the manufacturer (even though it is recognised as reflected in rental charges). The planned retention also reflects the realisation that spectacular improvements talked about are often years in reaching the stage of commercial availability. Results showed that increasing ADP loads will be met in many cases by combinations of small, medium, and large machines; they also reflect the growing interest in medium-sized machines.

CONCLUSIONS

Computer manufacturers other than the two leading ones in the field still have much to do to bring home an awareness of their particular equipment to potential users. Far too few users are familiar with available computers and components, and appear to make equipment choices on too narrow a base. Direct personal presentations and contacts appear to make the best media for getting the story across. This is coupled with the stress in equipment choice placed on the reputation and reliability of the manufacturer. Thus, the seminars and special meetings conducted by manufacturers, while costly, are in the long run the most effective sales educational efforts.

Responses to questions as to reasons for specific equipment choices show that price is not the prime motivation. The reason ranking highest—the desire for integration with existing punched card equipment—poses an educational problem for manufacturers. This is to stress the need for a fundamentally new approach to the data processing problem, and the potentials in new approaches to decision making, rather than the piecemeal, step-by-step approach tied to predecessor methods.

By and large, even though oriented to traditional methods, most users seem aware of the need to make intensive studies of systems and methods, and of the fact that these studies will require substantial time. Recognition of the importance of such planning is a benefit to the equipment manufacturers, for it takes the pressure from delivery date as a prime factor in equipment choice. Indeed, delivery date is shown to be at the bottom of the list of buyers' motivations.

NEED FOR GUIDANCE

Of the users who have 'been through the mill' in feasibility studies, equipment selection, and conversion problems, 75 percent admit, on retrospect, that it would have been well to have secured professional guidance in planning for the computer. This puts up a significant danger flag for those managements just embarking on an investigation of computer possibilities. While a company's own system and procedures (organisation and methods) people must obviously be immersed in the work, there are definite limitations to the 'do it yourself' approach. The field is so big and is moving so fast, and the immediate outlays and far-reaching expense implications are so great, that the failure to take advantage of qualified, objective professional opinion may be a costly economy.

Establishment of an 'Electronics Committee' (however named) is still apparently the most common organisational practice in planning. What must be avoided, of course, is the trap of protracted discussions and experience-gathering trips that delay over-long a forthright attack upon the problem. The relatively high proportion (23 percent) who indicate strong reliance on suggestions by manufacturers underlines the point already made

as to the value of direct personal contact. (At the same time, one is entitled to wonder about the possible correlation of this factor with the 'hind-sight' sensing of a need for objective guidance mentioned above.)

REJECTION REASONS

As significant as reasons for choosing a specific computer are reasons for rejections. It should be comforting to manufacturers that of the 45 percent who had no computer installed or on order, only 40 percent had definitely rejected the idea at the time they were queried. Here cost did play a part—almost half of the rejections being on that ground. This comes down to less than one sixth of the group still to be interested. Recent developments in medium-sized computers and increasing versatility of computers should play a favourable part here.

As to operating practices, two-thirds indicate centralised computer activities, approximately 30 percent are partially centralised and decentralised, and only five percent are completely decentralised. From other evidence, it would appear that the 'hybrid' group will increase, with smaller satellite computers feeding into a centralised station where large-scale equipment will handle the bigger and more complex jobs. If our judgment on this point is correct, more attention will be called for on source data automation, data transmission, and translation from one machine language to another.

APPLICATION TRENDS

While computer time, as was to be expected, is heavily used for historical accounting work (payroll, accounts receivable, inventory control, etc) plans of users indicate a lively interest in management science applications—mathematical simulation and mathematical development of management data. The trend in hardware toward computers almost equally adapted to business data and scientific computations will further stimulate this interest.

Over nine-tenths of users take advantage of automatic programming techniques, and other evidence indicates that this interest is increasing. Manufacturers are continuing their constructive work in this area, and the developments here should serve to reduce the substantial time indicated as currently expended on debugging, as well as to widen applications as the computer 'language' becomes less esoteric.

Ratings on over-all experience with computers are highly gratifying, although, as stated, the 10 percent indicating relatively low degrees of satisfaction should not be too lightly dismissed, in view of the size of investment involved. It is doubtful whether any field representing a comparable innovation could, after so short a period, match the almost 60 percent expressing satisfaction in degrees of 100 to 150 percent, and 90 percent registering satisfaction of 75 percent and over. This is especially significant when coupled with the fact that very little direct clerical savings are reported, with 18 percent of users actually reporting increased clerical costs after computer installation (although, of course, regarding that figure no cognisance is taken of possible increased work loads, additional uses, and the like). Reduction of costs was put last in a value rating of areas where the computer has proved to be of most value—outranked by increased speed of processing, reduction of errors, and development of management information.

SYSTEMS PROBLEMS

Conversion of raw data is by far the most heavily indicated weakness of current ADP programmes. This is simply a confirmation of related points brought out in the survey, having to do with advance planning, outside guidance, and the like. This factor is continuously encountered by Diebold engineers in the field—where the great bulk of transition difficulties are traceable to having the machine installed too soon, before systems work and personnel training were ready for it—with consequent top management pressure for 'results' from the costly operation leading to hasty and ill-advised applications. Underscoring of this point is further provided by the specific listings of difficulties experienced, where problem definition, selection and training of personnel, and programming rank high in the order listed.

Some 39 percent of users expect to keep their computers for more than five years, and another 22 percent expect to keep them at least 5 years. This indicates that they do not look upon the problem of obsolescence as particularly disruptive, although for those who own the equipment, these periods are shorter than the allowable amortisation periods for electronic equipment. Reflecting practice and trends already mentioned, most users and potential users are looking forward to medium machines, or combinations of small, medium and large machines, to meet business data requirements over the next five years.

A wide variety of results pour out from Bristol Aircraft's two computers, which form the nub of a mathematical service department, but basically these are concerned with two types of calculations—design and development calculations, and processing data obtained during the testing of aircraft and missiles

How they take the guesswork out of aircraft performance

by J H M COCKAYNE

IN recent years the task of the aircraft designer has rapidly become more and more difficult as operating speeds and heights have become greater and aircraft themselves more complex. With the need to eliminate all guesswork, to know in advance and as accurately as possible just how an aircraft or a guided missile will behave in any one of a variety of conditions, the designer has come to lean heavily on the mathematician. The mathematician, confronted by urgent problems which normally would tax the combined brains of a whole team over a period of days, and often months, has increasing recourse to modern electronic computing aids.

The growing volume of mathematical calculation resulting from all advances in all fields of aircraft design has led to the formation of a mathemat l services department within the design office of Bristol Aircraft Ltd.

With two English Electric Deuce computers as the heart of the section, the department is the most powerful section of its kind in the British aircraft industry.

Before taking a look at the main types of problem that the mathematical department is called upon to deal with, it is perhaps worth giving an indication of the comprehensiveness of the section and mentioning some of the equipment that is used.

Programming Staff

Programming for the main computers is carried out by a team of 14 mathematicians and technical staff. Programmes are verified by their author on the computer itself; usually the final stage in testing ls to run a test calculation on a problem whose solution is already known.

A punched card section, staffed by seven operators, prepares the data cards for the computer and

also has the task of tabulating the answers in readable form. Equipment used by this section includes two IBM type 420 tabulators, a number of automatic card punches and verifyers, a reproducer, a collator and a sorter.

The punched card section is a most useful data processing facility in its own right. Many jobs which need not call on the full capabilities of the Deuce computers can quite satisfactorily be performed by the section. An example of one of the useful services which it can undertake is the maintenance of up-to-date weight statements of the different variants of Britannia airliners. Every one of the many thousands of components which go to make up the complete aircraft is classified either according to geometrical location in the airframe or according to its function—whether part of the hydraulic system, for example, electrical installation or perhaps part of the interior furnishing.

Index of Modifications

No aircraft ever remains in the same state as it left the production line—improvements and refinements are continually being made and the list of modifications which can be incorporated on an airliner the size of the Britannia can reach frightening proportions. A complex index of all these modifications is kept on punched cards and it then becomes a relatively simple matter to sort out the current modification states of individual airliners, an important function since individual customers will often require different sets of modifications to be incorporated in their aircraft.

A desk calculating machine section, using Friden machines, handles other small jobs which are not worth submitting to the large electronic computers. Duties of the section include the provision of a calculating service to engineers and technicians and related ancillary jobs such as the plotting and reading of graphs.

A highly specialised section known as the lines analysis group performs a vital service in the production of highly accurate geometrical information which can be used for defining the over-all lines of an airframe in the earliest stages of design. Certain vital geometrical information relating to the main or internal structure of an aircraft can also be obtained. The use of mathematical expressions can also be of great benefit in production since if the shape of a certain member can be defined mathematically, an absolute standard is provided which avoids inaccuracies and errors of reproduction inherent in the use of templates for defining ' master ' shapes.

Computer Problems

Returning now to the two Deuce computers, let us examine some of the specialised problems which these machines are called upon to solve. These are split into two main categories, design and development calculations and data reduction calculations—the processing of data obtained during the testing of missiles and aircraft. From a

Bristol Aircraft employ a programming team of 14 mathematicians. Each programmer verifies his own work on one of the machines

technical viewpoint the work can be further subdivided into that concerning guided weapons, aircraft and helicopters.

Prediction of Trajectories

Much of the work on guided weapons currently consists of trajectory predictions. Before a projected missile concept has even reached the drawing board, Deuce may be brought into play. From the rough specification the department is able, knowing the various required characteristics of the missile, to simulate trial firings and interceptions, thus producing valuable information to set the designers on the correct lines.

Within the mathematical services department jobs not worth doing on the computers are tackled by a desk calculating machine section

Modifications to be made to airliners are recorded on punched cards to produce an up-to-date modifications index

As the design progresses, the established characteristics of the missile are passed back to the department for re-examination, enabling any necessary changes to be made in the earliest stages. As the missile begins to emerge in its production form, the problems placed before the department become very much more detailed, and such factors as radar ' noise ' and ' glint ' from the target are built in to the theoretical firings to see how the missile will perform under difficult conditions. The effect of evasive action taken by the target and also performance of the guidance system against counter measures can be established. Since every actual missile test flight would be a ' once only ' operation, the saving in both cost and time afforded by computation of this sort is immeasurably great.

Radome Aberration

A problem common to a large number of homing missiles is that caused by radome aberration, or the bending of radar reflections from the target by the actual radome which covers the receiving equipment in the missile. In eliminating this difficulty in the design of Bloodhound, theoretical work carried out by the department played a vital part. Studies were made to establish the effect of aberration on the accuracy of Bloodhound and resulted in an optimum design for the radome and also confirmed the wisdom of the choice of a ' twist and steer ' type of control system.

Aerodynamic and Structural Studies

In addition to studies in the field of control and guidance the Deuce is able to assist with dynamic, aerodynamic, aeroelastic and structural studies. A further type of investigation consists of a statistical study to show theoretically the percentage chance of destroying all of a large formation of aircraft with a given number of missiles and target-illuminating radar units. This latter leads to defence studies which can be carried out to show the optimum numbers and strategic placing of missiles to defend a given area, taking into account the nature of the terrain and also the type of attacking target which will have to be destroyed.

So much for design and development. All of the work so far described could be completed without the need for a single missile to be fired. But the entire development of a missile cannot be carried out theoretically and it is during actual firing trials that the data processing abilities of the department perform an important function.

Trials Data Analysis

Trials data analysis can be summed up briefly as the task of reducing the mass of information

obtained during missile firing trials into a form which can be easily assimilated by the engineers and technicians. This information comes from various sources and in different forms from telemetry stations in the form of magnetic tape, from doppler stations and from missile tracking stations on high speed film. Since most of this data is subject to random discrepancies caused by ' noise ' effects and unavoidable experimental errors, Deuce must first carry out a ' smoothing ' process before proceeding with the analysis.

Wind Tunnel Testing

Turning now to aircraft, much of the data reduction work which the mathematical services department performs in this category is concerned with wind tunnel testing. Bristol's main wind tunnel is equipped with automatic balances from which the loads on the model under test are obtained in the form of electrical signals. These readings are digitised and transmitted along a land line direct from the wind tunnel to an automatic punch in the mathematical services department. The wind tunnel data are then fed into Deuce and the results of the test can be back in the hands of the wind tunnel experts within minutes of the test being completed. The main function performed by Deuce on these wind tunnel readings is the elimination of interaction between the six different force components which are measured by the balance mechanism. The corrections emerge from Deuce in the form of punched cards which are read by an automatic card reader and transmitter, and are passed back along a telephone line to an automatic typewriter in the wind tunnel control room.

Investigating Aircraft Performance

Other fields of work covered by the department in connection with aircraft include important investigations for the design office relating to flutter and aircraft stability. Performance investigations cover such aspects as take-off, climb, cruise, manœuvre and landing calculations. A wide range of structural calculating is also undertaken including studies of the effects of kinetic heating and thermal stresses. Studies of this nature have played an important part in the development of the company's all-steel supersonic research aircraft, the Type 188.

In support of the company's sales effort, the department is also employed in drawing up analyses of the routes over which the prospective customer would be flying his airliners. Set programmes have been evolved for this type of operation, and such details as block speed, cruise speed, payload, landing weight, fuel consumed, reserve fuel and total fuel required can all be worked out for a given route under varying wind conditions.

Work relating to helicopters includes rotor performance analysis, a very much more complicated business than the performance analysis of a fixed wing. A dynamic study, this problem is from a mathematical point of view largely similar to that of flutter and also calls for a great deal of computation. As in the case of fixed wing aircraft, weight breakdowns and centre of gravity analyses are also carried out by the department.

The twin-hub of the design offices' mathematical services department—the two Deuce machines

Client programmers do a good deal of their work in a room set apart for them at the centre

THE COMPUTER CENTRES AT WORK—**5. FERRANTI**

The majority of clients who come to the London computer centre of Ferranti Ltd treat the centre as an 'open shop,' doing most of the work themselves

Clients hire computing time at a 'SELF-SERVICE' centre

by PHILIP MARCHAND

ROUGHLY once every two months one of the directors of a firm of construction engineers sends his secretary to Ferranti's computer centre in Portland Place, London, with a batch of calculations relating to the stresses concrete will withstand. The girl punches onto paper tape the data for the calculations, and also, explains Mr A R Bagshaw, who heads the computing service, operates the computer 'as she likes doing this' — though of course under the complaisant eye of one of Ferranti's operators, in case she should run into difficulties.

This job, which costs on average £5 a time, even if it is not typical of the work that is done on the centre's Pegasus, does illustrate Portland Place's approach to service work. Clients are encouraged to help themselves, to do their own programming and prepare their own input tapes. In fact 80 percent of the work processed at the centre is prepared in this way by clients. Ferranti stress

that in general it is much more difficult for a member of their own staff to learn and come to grips with the problems of an outside organisation than for a would-be client to learn how to programme and put his problems onto a computer.

Ferranti have put over 1,000 people through their programming course for Pegasus and estimate that of these some 500-600 are active programmers at present. Of course a large proportion of these are writing programmes for organisations that have purchased their own Pegasus machines, but the balance represents a good deal of industry which is finally proved in Portland Place.

SERVICE FACILITIES

While the centre operates an 'open shop' policy, it also offers, for those clients who want it, a complete service. Complete jobs involving system study assistance, writing programmes, preparing punched tapes, operating the machine, and printing out results onto stencils have also been done, and the centre retain 26 programmers and a team of three full-time tape-punching operators for this work.

In addition, the centre has two facilities to offer clients: it claims to have the largest programme library of any British computer manufacturer, with 120 fully written programmes or subroutines, and a further 600 programmes are available through an interchange scheme with Pegasus users in the universities and business. Ferranti have also developed an autocode for Pegasus, which cuts out the need to learn how to programme the centre's machine, but which makes it possible to instruct and put work onto the machine in a very short space of time. For the simple-language autocode can be learnt in as little as two days. In some instances programmes have been written partly in autocode and partly in conventional machine language. One job for example that was tackled in this way involved processing the data from a gasifying plant which had been recorded on paper tape by a data logger. The centre wrote an input routine for the data in conventional machine orders, but the remainder of the programme was written in autocode by the client, who alone knew exactly how to analyse the data.

THE PATTERN OF WORK

The Ferranti centre began taking in other people's problems in the spring of 1956 and to date some 130 clients have used its facilities. With Ferranti's own bias in electrical engineering it was natural that early jobs done for outside organisations should be aircraft and electrical engineering firms, and in fact a breakdown of the centre's work carried out as recently as early 1958 showed that 60 percent of machine time has been devoted to calculations for these industries. However, at present the pattern is changing—as several aircraft companies have purchased their own computers and new clients have come to the centre.

This present work still falls largely into the loose category of 'statistical and scientific' jobs; a limited amount of clerical data processing work has been attempted. Examples of statistical and scientific work include simulating a hydro-electricity system on Pegasus, work on the theory of railway operations, testing the randomness of ERNIE, the Post Office's device for picking winners among premium bond holders, and 'cut and fill' calculations for road-making contractors.

More obviously commercial ventures have been a route planning job for deliveries for a well-known manufacturer of dry batteries, production control for a camera company, the simulation of the operations of a textile mill, as also the operations of machine shop, and optimisation work involving the use of linear programming techniques to calculate what to put into cattle food mixes.

The centre has also had its share of insurance work. One job that was done for a large group of insurance companies on premium rates involved producing half a million documents and preparing 448 tables on addressograph-multigraph paper so

Head of the Computer Centre, Mr A R Bagshaw, will soon be able to offer time on two machines

The centre's Pegasus is now equipped with tape decks and also a Soroban output punch (right, centre)

that several copies of these could subsequently be printed out on an offset litho machine.

The idea of using a centre to process data on paper tape which has been produced on an accounting machine is also beginning to take root, and the centre have prepared programmes for clients who use Sensimatic accounting machines with tape-punching attachments. The programmes analyse the data and the clients receive the results in tabulated form.

A more esoteric programme—which has already been written in autocode—is for the business game, which was originally devised by Bellman of the Rand Corporation, USA. Ferranti are the second company to develop a programme for this game (introduced here by IBM, see *Automatic Data Processing*, June 1959, p. 23), and while no client has yet made use of this programme, the centre is confident that, as the value of the game becomes more widely appreciated, it will be run on the machine frequently.

MORE CLERICAL WORK SOON

The centre to date has undertaken only a limited amount of regular clerical work. This, Mr Bagshaw points out, was not practicable to put on the centre's machine until magnetic tape units had been hooked up to the computer, as most commercial data processing applications required a large file store. The two Burroughs Electrodata tape units and a Decca twin unit, which the centre has installed, will remedy this.

The centre's Pegasus is also to be equipped with punched card reading and punching units, and also a card-operated line printer. At present, the centre's machine makes use of paper tape as both the input and output medium, and can use two tape readers and three punches, one of which, an American Soroban punch, hits out 240 characters a minute.

In addition to the present Pegasus computer, the centre has installed a small desk-size Sirius machine, which will be able to tackle some of the smaller jobs and as it will cost only £15 an hour to hire, it may be able to do these more economically than if they were processed on Pegasus.

Ferranti charge £50 an hour for machine time on Pegasus and quote contract terms to clients for programming and data preparation effort by the centre. These are the only charges they levy. No charge is made for the other facilities offered to clients. When a client first comes to Portland Place a member of the staff is detailed to liaise with him, help to debug programmes and assist in any other way. The client is of course free to come to the centre without contacting his guardian angel, but can consult him whenever he likes—free of charge.

WAGONS UNDER CONTROL

Arnold E Keller

'Car-Fax' Brings a New Era in Railroading

Management and Business Automation May 1959 (USA)

The Chicago and North Western railway has introduced a system called 'car-fax,' linking 68 field stations along 9400 miles of track to the Chicago office, where wagon and train movements are controlled throughout the railway. The equipment used is the IBM transceiver with punched cards and rented telegraph lines. Once the originating station has punched data in the cards, all steps are automatic.

About 3000 wagons are loaded daily, others are released after unloading. Empty wagons are ordered by despatching companies. About 5000 wagons, empty and loaded, reach 222 interchange points daily; 5000 more go daily to other railroads. About 25,000 wagon movements are made on 300 trains.

A systems study was started late in 1956 and completed in a year. Twenty-five men were selected and trained as instructors in the automatic system, which was started on the least complicated section of the railway. This change-over took about a month, including the training of operators.

The key to the system is the waybill, from which essential information is keypunched at the station of origin. This is the only manual operation in the system, which gives information far in advance to all points in the railway system at which each wagon will have to be handled. All information goes through the Chicago centre, where it is analysed for traffic, operations and accounting departments. A complete tracing report is compiled nightly.

The system has greatly increased efficiency and control of the rolling stock, and has had the effect of making more wagons available—a vital gain.

INTERNATIONAL CONFERENCE ON INFORMATION PROCESSING

Several papers read at this conference were of general interest. Short abstracts of two of them appear below. Others will appear as space allows.

T Kilburn, R L Grimsdale and F H Sumner (Britain)

Experiments in Machine Learning and Thinking

Experiments have been carried out on the Manchester University computers to demonstrate 'learning' and 'thinking' by machines.

A digital computer has been successfully arranged to generate its own programmes. The machine is supplied with a set of criteria which the generated programmes must satisfy.

A number of methods are available by which the machine will improve its ability in programme generation. In one of these a feedback system is employed in which the probabilities of selection of the various instructions are varied according to the success of the generated programmes, thus enabling the machine to learn the most suitable programmes to use. The machine can also learn from experience, because all successful programmes are remembered and the machine can generate new programmes by modifying or adding to these. As the machine gains experience the rate of production of programmes and their complexity increase.

G W Hughes and M Halle (USA)

On the Recognition of Speech by Machine

The paper discusses problems involved in designing a device capable of distinguishing among speech events normally recognised as different. Parallels are pointed between these problems and those of chemical analysis. The entities to be analysed are considered as complexes of a restricted set of ultimate constituents: elements and subatomic particles in chemical analysis, phonemes and distinctive features in linguistic analysis. Speech recognition programmes embodying this and other theoretical concepts were put onto a digital computer.

Names and Notes CONTINUED

In addition, however, the computer will be used for calculating the most economical, and yet nutritional, ingredients to put into a variety of animal foodstuffs.

The company's managing director, Mr E B Stevenson, reasons that the machine will enable the company to integrate its previously distinct mathematical and accountancy work.

▶ The prime motive of Bruce Peebles' decision to install a £60,000 Pegasus computer — to be delivered next year — is to be able to do fundamental research and design calculations on it. It may also be used for such clerical tasks as production control and sales analysis.

Moving up—and in the Boardroom

FROM IBM's Birmingham office, Mr D J N Stirton moves to London to become sales manager of the data processing division. After joining the company in 1952 as a salesman of data processing equipment, Mr Stirton gravitated to Birmingham in 1954 to head the IBM office there.

Recently appointed to the board of Leo Computers Ltd were Mr D T Caminer, Mr A B Barnes and Dr J M M Pinkerton. Mr Caminer will be specifically responsible for the marketing and consultancy activities of the company; Mr Barnes for production, commissioning and maintenance services; and Dr Pinkerton for new developments and design.

Knocking the Brain

'THE AVERAGE human brain,' a conference of principals and lecturers of commercial colleges heard recently, 'if lectured to all day will retain only seven percent of what it has been told.' The next day, however, it will be able to recall only ten percent of that seven percent. On the other hand, lecture a computer in its own language and it won't forget a fact.

This conference, a two-day seminar organised by the National Cash Register Co Ltd, and devoted to introducing commercial college academics to electronic data processing, outlined how a computer works, and—more important—how it is made to work on business problems.

(Perhaps the business scholars carried away a useful seven percent of knowledge to disseminate in their own colleges—or will someone recant and say the statistic was not quite accurate?)

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DIGITAL COMPUTER PROGRAMMERS

Mathematicians, who are interested in developing methods of calculation, using advanced digital computers, to solve problems arising from physics research, are invited to apply for vacancies at Harwell and Winfrith in the scientific and experimental classes as professional programmers.

A Computing Group is being formed at the ATOMIC ENERGY ESTABLISHMENT, WINFRITH, Dorset, which will be a national centre for reactor research. A MERCURY digital computer will be available and there will be access to an external IBM 704 computer. The problems to be studied will concern many physical and engineering aspects of reactor behaviour. The work must be conducted to a high academic standard and members of the team will be encouraged to take an interest in the whole field of reactor theory.

The Computing Group at Harwell uses a MERCURY digital computer, and also has access to an external IBM 704 computer. There is a wide variety of problems to be studied, including methods of solution of the neutron transport equations, the properties of discharges in plasmas such as those in ZETA, the design of high energy particle accelerators, crystallography and data processing.

These Computing Groups, besides maintaining close contact with the large scientific effort at the Harwell and Winfrith Establishments, will also be the focal points of their considerable interest in numerical analysis and mathematical and programming techniques.

QUALIFICATIONS

Candidates, for posts as Scientific Officer, Senior Scientific Officer, or Principal Scientific Officer, should have 1st or 2nd Class honours degree (or equivalent) in mathematics, physics or engineering. Candidates for posts as Assistant Experimental Officer, Experimental Officer or Senior Experimental Officer should have G.C.E. in five subjects including two scientific or mathematical subjects at advanced level or equivalent qualification. Possession of a degree in mathematics would be an advantage. Candidates for the senior posts, in both scientific and experimental classes, will be expected to have experience in numerical analysis and programming.

SALARY

Within the range £675-£2,155 p.a. according to age and experience for the Scientific Officer class.

Within the range £500 (at age 20) £1,685 p.a. according to age and experience for Experimental Officer class.

Send postcard for an application form to:

Group Recruitment Officer (1443/297),

U.K.A.E.A., A.E.R.E.,

Harwell, Didcot, Berks.

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Owing to increasing expansion, there are several vacancies in the Consultancy and Marketing Division of LEO Computers Limited for men and women under 27.

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Write for Application Form to The Personnel Officer, LEO Computers Limited, Elms House, Brook Green, London, W.6.

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